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For OCTOBER, 1946

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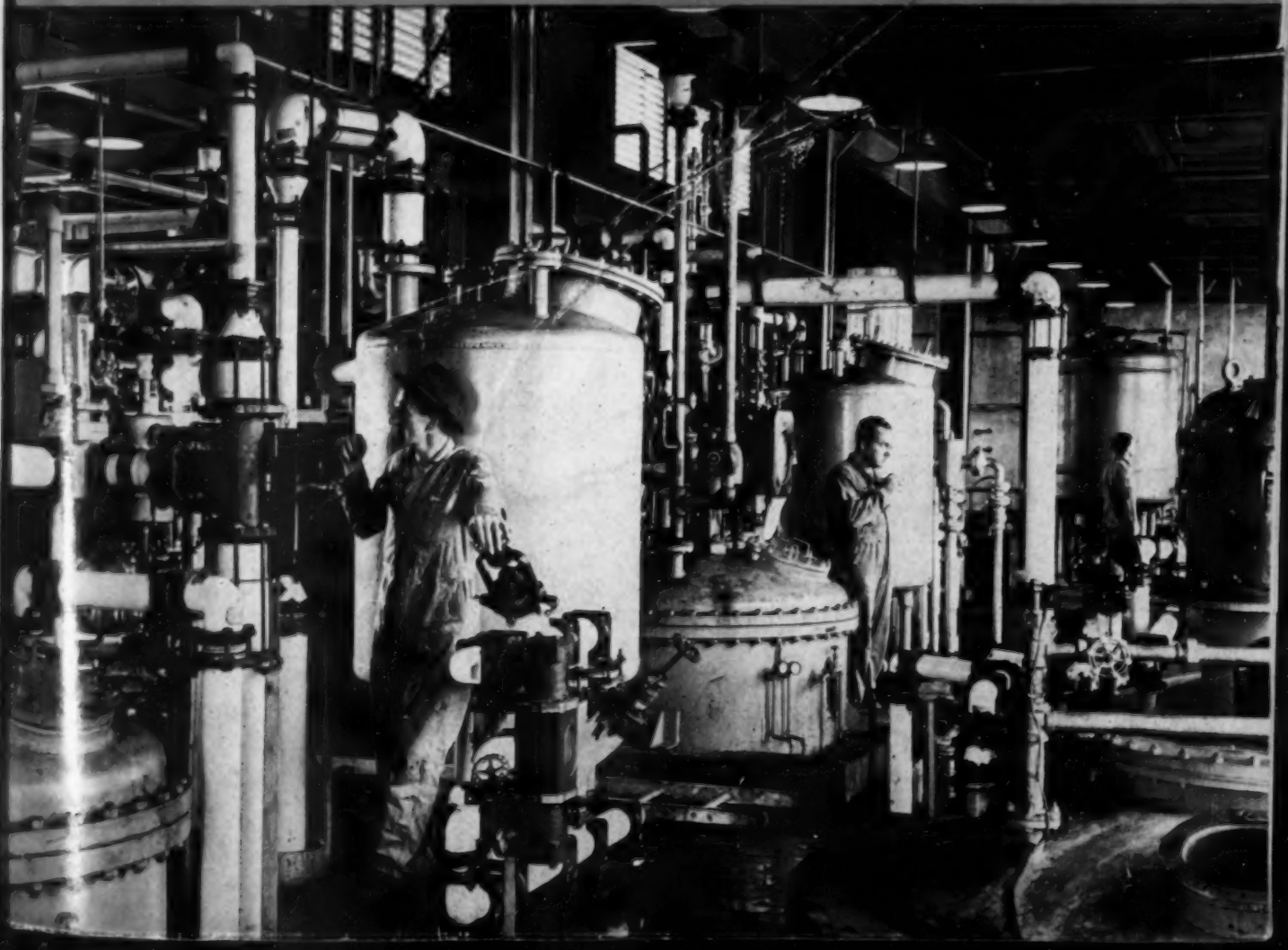

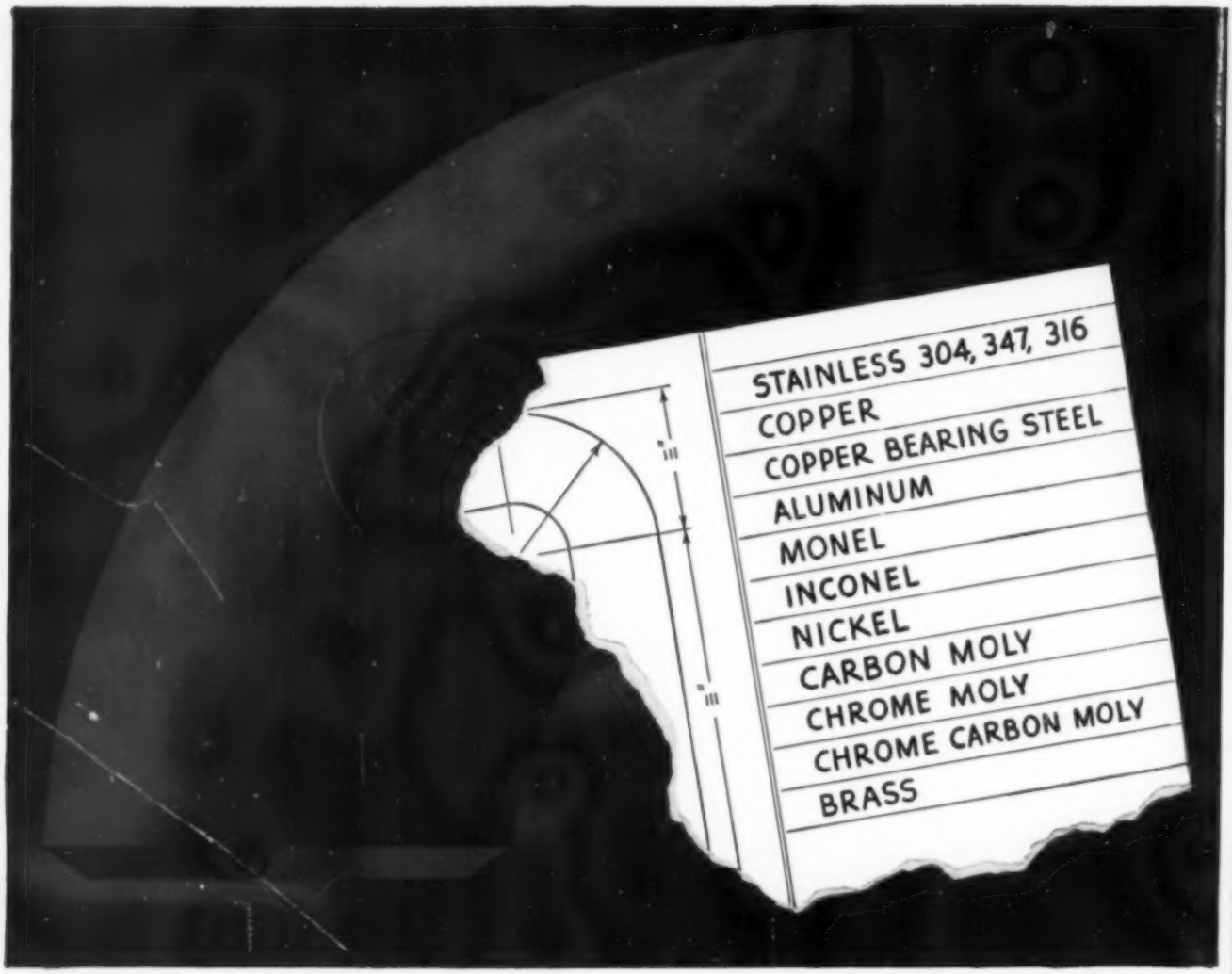

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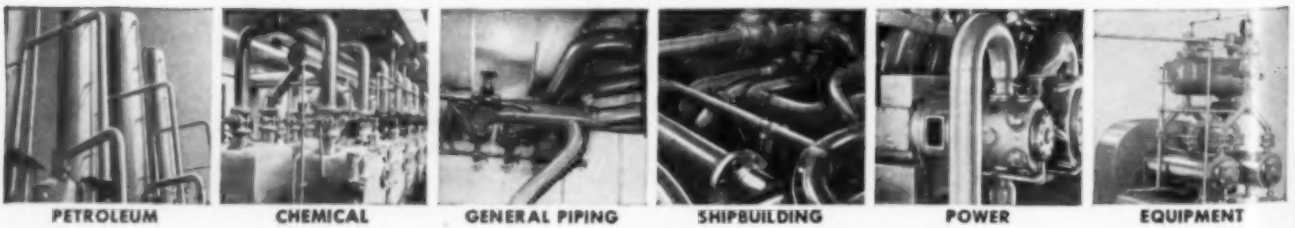

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CHEMICAL ENGINEERING

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Volume 53 — Number 10

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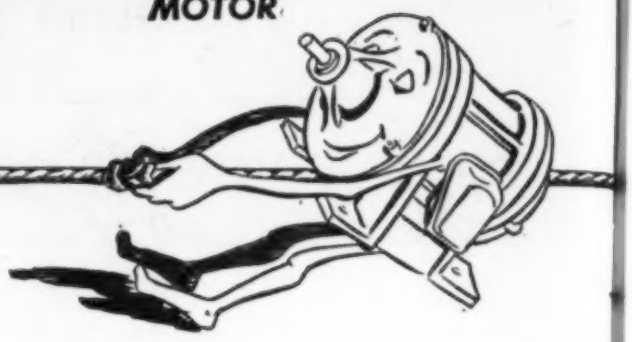

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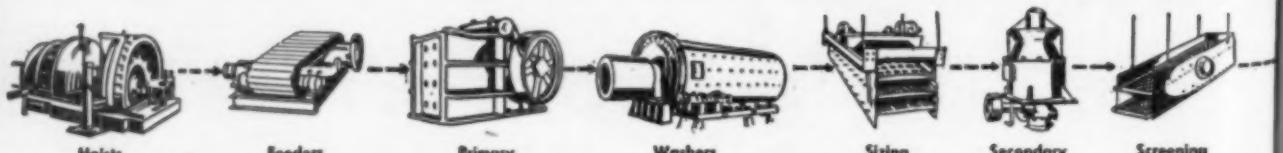


A FREE ECONOMY IS WORTH FIGHTING FOR

BUSINESS must take the initiative if the price decontrol machinery, set up by Congress, is to be effective. The present price control law is far more than a set of instructions to the administrators of OPA; it is a challenge to business to be aggressive in speeding decontrol decisions and in persuading the Price Decontrol Board to adopt a strong stand for return to a free economy.

Thus far business has not met this challenge. *Two months after the passage of the new price law not a single application for decontrol of a major product had been filed by an industry advisory committee.* This is due in part to the red tape controlling such applications. Nonetheless, a continuation of such inactivity on the part of business can well result in perpetuating price control far beyond the time either the present law or sensible economic policy require.

It was the clear intent of Congress to hasten our return to a free economy. In the legislation continuing the general control of prices, Congress formally declared its purpose to have it "terminated as rapidly as possible."

To accomplish this, the House originally approved a formula which would have made decontrol mandatory when production had attained a prescribed level. The automatic decontrol provision was dropped before the bill was finally passed, partly because of the uncertain effects of strikes on production. But Congress did not mean to return the timing and extent of decontrol to the administrative discretion of OPA.

On the contrary, to assure having price control "terminated as rapidly as possible," Congress created a Price Decontrol Board and gave it power to overrule OPA when the board finds price control should be removed. Moreover, it gave to industry the right and the responsibility to seek decontrol. Also, in a further effort to speed up the decontrol process, it placed narrow limits on the time allowed for board decisions.

Congress had compelling economic reasons for doing its legislative best to speed up decontrol.

1. It is by all odds the best way to eliminate the bottlenecks in production and the black markets which have plagued the country since V-J Day.

   Rigid price ceilings promote shortages of badly needed commodities by discouraging their production. Such shortages both upset the flow of production and promote black markets. At present a considerable part of American industry is stymied by shortage of critical parts and materials. Price control is much to blame.

2. There must be flexibility of prices if a round of new wage adjustments, which may be forced on industry early in 1947, is to be negotiated without grave risks of seriously curtailing production.

   When, under the leadership of the national administration, the first post V-J Day round of wage adjustments was made, price ceilings were held rigid while wages were boosted. The result was a series of price-wage squeezes which upset production. They would have been disastrous if we had not been in a sellers' market, created by a tremendous accumulation of wartime shortages. In 1947, however, many industries will be in a buyers' market. It must be possible, therefore, to have wage increases reflected promptly in price adjustments if we are to avoid a repetition of the costly post V-J Day round of strikes, which often had price control as the key issue.

3. Rapid decontrol is necessary to maintain a high level of employment and production.

   Almost five years of price control inevitably twisted the factors of production and distribution far out of the equilibrium which would prevail in a free economy to which it is the clear purpose of the nation to return. Unless the return to a free economy is facilitated by a speedy and orderly decontrol, the jolt of an abrupt return to competition can be expected to upset employment and production seriously.

It's Up To Business

To encourage speed and boldness in decontrol, Congress provided for the reimposition of control over any prices which, after being released, might

get out of hand. The dangers of this sort are chronically exaggerated. During the 25-day period in July when there was no price control the Civilian Production Administration found that "manufacturers of finished industrial and consumer products have generally exhibited commendable restraint in increasing prices no more than increased costs."

All of this endeavor to speed up decontrol and expand its scope is likely to be futile, however, unless business furnishes the driving power for the machinery Congress provided. OPA certainly will not do it. Neither can the Decontrol Board be expected to go out and drum up cases.

The necessity for vigorous action by business in pressing for decontrol is increased by the fact that the general legislative standards to guide decisions by the Decontrol Board are vague. They must be clarified and sharpened by decisions in specific cases.

The main principle to guide the decontrol of non-agricultural products is that price ceilings shall be removed when supply is in approximate balance with demand. But what precisely does that mean? The meaning will become clear only through Decontrol Board decisions.

The same is true of the principle which makes automatic decontrol of a non-agricultural commodity contingent on whether or not it "is important to business costs or living costs." Business must press cases which will give specific meaning to those vague terms if decontrol is to get on apace.

Cards Are Stacked

At present the government has the cards pretty well stacked against rapid decontrol.

First, the key members of the staff of the Price Decontrol Board are holdovers from the Bowles regime which emphasized the importance of carrying on price control rather than speed in getting rid of it.

Second, in exercising his authority to prescribe regulations to govern petitions for decontrol, the OPA administrator has required excessively complicated statistical and economic data. Manufacturers who are sure they can convince any fair-minded board of the desirability of decontrolling certain of their products assert that they are blocked by statistical entanglements.

Third, OPA has discouraged business from moving immediately under one section of the law to speed decontrol. This section provides that products "not important in relation to business or living costs" may be freed from price ceilings immediately and must be freed by December 31, 1946, unles OPA specifically finds they are important to these costs. Instead of making it possible for business to move under this section now, OPA has issued rules which have the effect of blocking such a course until the end of the year.

In the light of obstacles such as these, it is not surprising that the record of decontrol to date is not impressive.

Decontrol Record

Since June 30 there has been a drop from about 70% to about 60% in the total value of products under price control. But most of the drop has been accounted for by food products, which Congress took the lead in decontrolling, and by industrial machinery which was being decontrolled when Congress acted. By far the larger part of manufactured consumer goods remains under control.

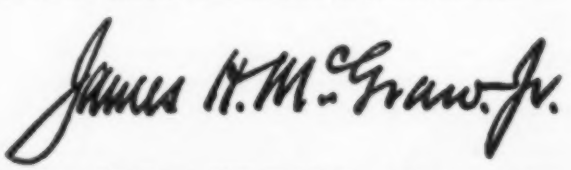
This, however, is no time for business to be discouraged. Rather, business should accept the obstacles put in its way as a challenge and work harder than ever for speedy decontrol.

The case for decontrol should not be stated in narrow technical terms. It should be based on grounds of broad public policy, and should demonstrate how a speedy return to a free economy can hasten the full release of the nation's productive power.

For example, there should be very clear demonstrations of how, in far too many cases, rigid price ceilings—(1) discourage production of key parts and materials by making such production relatively unprofitable, (2) create shortages of key parts and materials which tie up broad ranges of production or result in piling up lopsided inventories of partially completed goods, and (3) thus cut away the foundations of a stable economy and the prospects of steadily sustained employment.

There should be equally full demonstrations of the well known sequence from shortages to unrealistic price ceilings to black markets. Meat prices are rolled back, but the meat is rolled under the counter.

A free economy is worth fighting for. Liberty is preserved only by the constant struggle of those who believe in it. Neither the interests of the nation in a strong and well-balanced economy nor the interests of business itself will be served by drifting at this time. Now is the time for business to lead a strong offensive for speedy elimination of price control.



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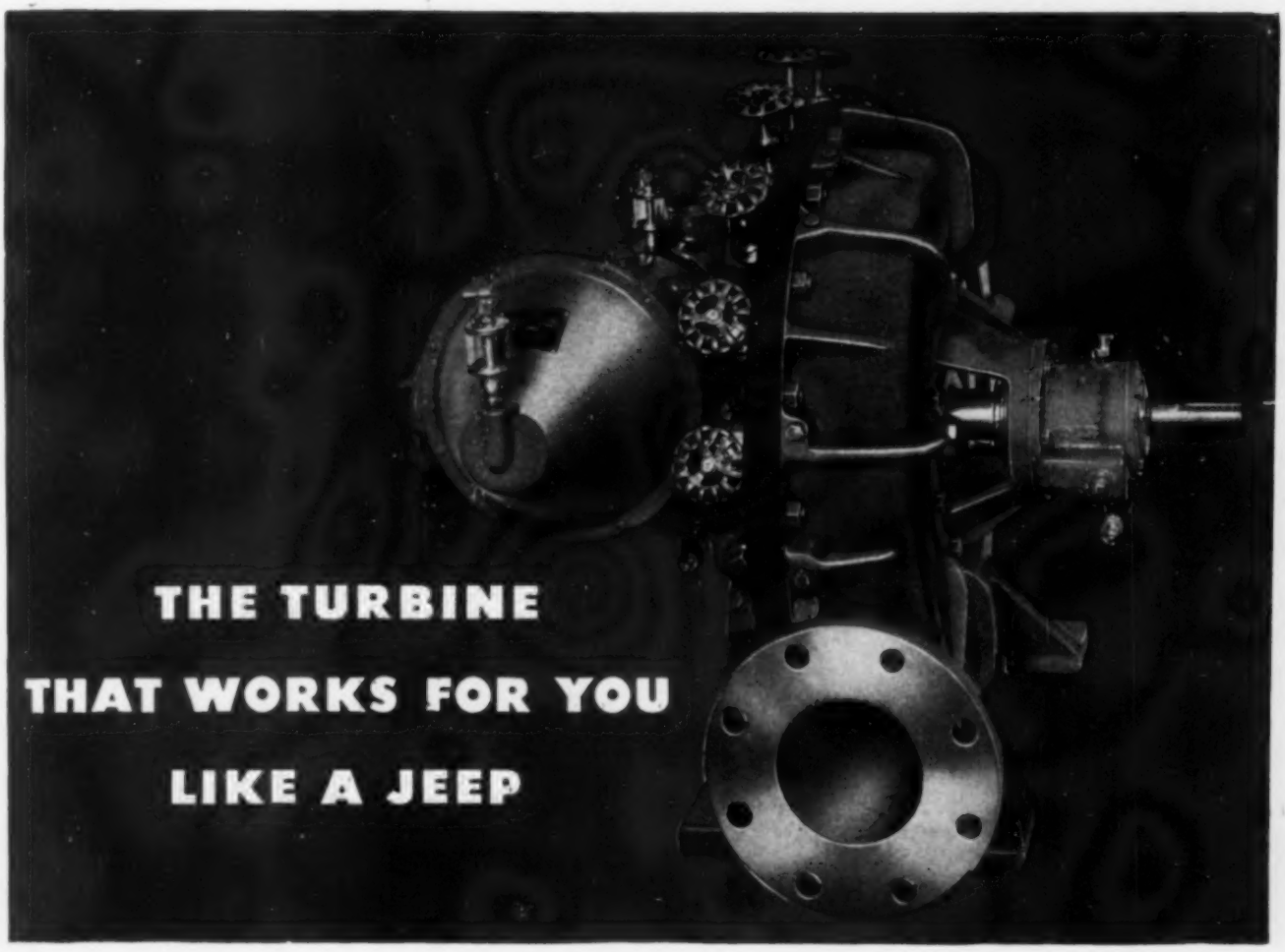

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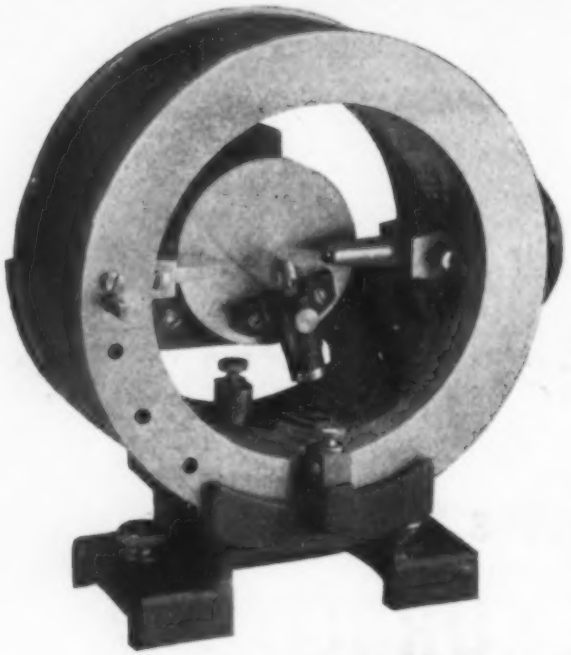

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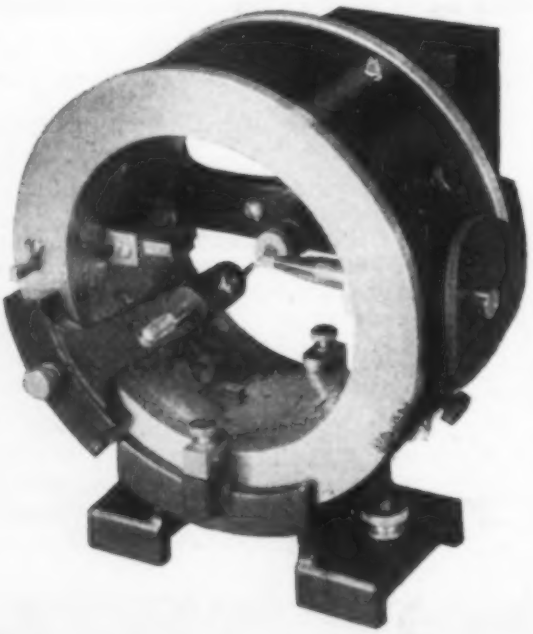

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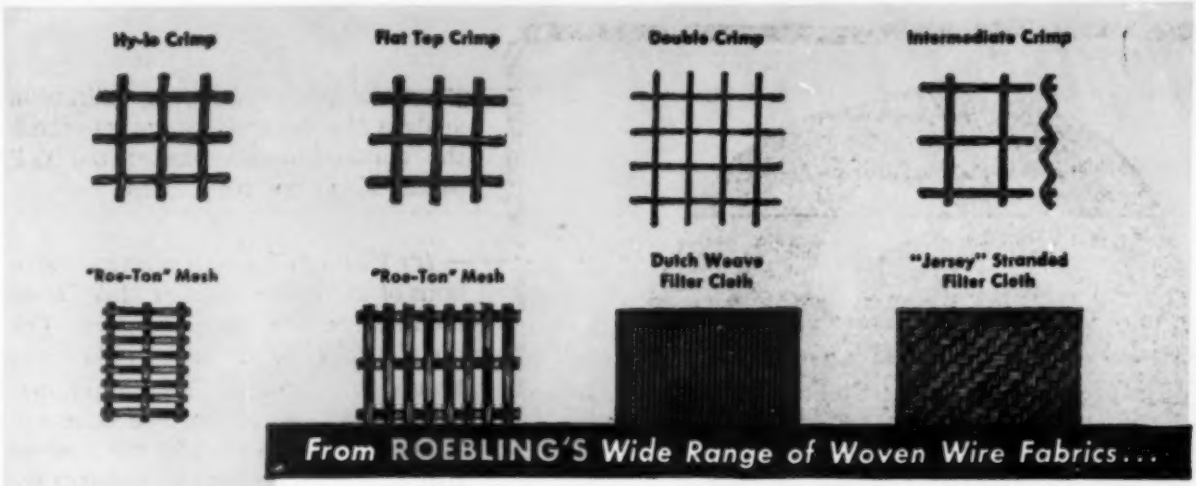

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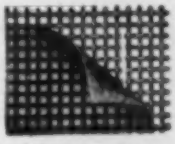

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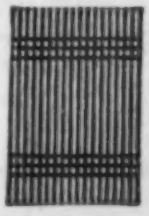

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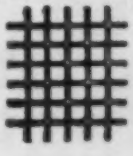

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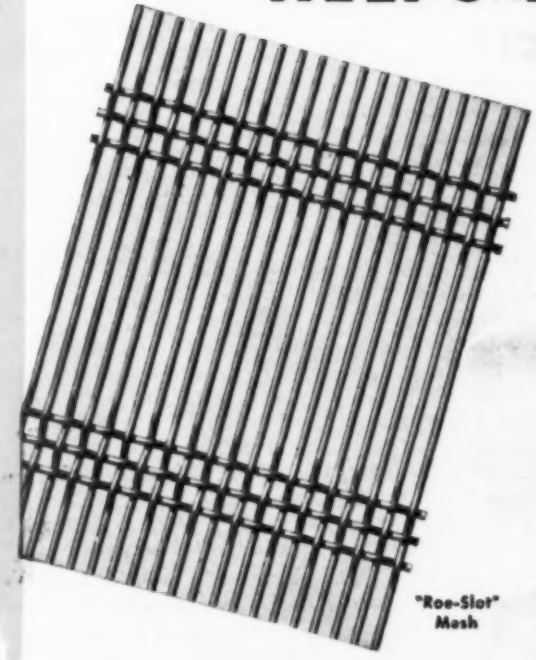

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Industry may be asked to formulate an agreement of fair trade practices . . . New survey of power requirements for electrochemical manufacture . . . Services of German scientists will be confined to military work . . . WAA removes some nitrogen plants from surplus list . . . Commerce Department gives tentative approval to placing two research contracts . . . New strategic list compiled as aid to stockpile program . . . Bureau of Labor makes study of man-hour productivity . . . More workers in chemical plants may get draft deferment . . . American research scientists sought for long-term work in Australia . . . Corn allocated for alcohol manufacture

FTC POLICIES CHANGING

INDICATIONS in Washington are that there will be an acceleration of changes in the Federal Trade Commission's policies toward business which became apparent after President Truman's expression of interest in the matter last June. At that time, in a message transmitting to the House, estimates for a supplemental appropriation to enable FTC to put into effect a reorganization plan outlined last February, the President summarized his views.

The Administration, according to competent opinion in Washington, is desirous of ending what in some critical quarters has been described as "witch-burning" tendencies in FTC in favor of making that agency a "business man's court." The supplemental appropriation, part of which was granted, was sought in order to effect this conversion. Portions of the reorganization already have become operative. Whereas formerly the Commission seldom issued statements explaining reasons for, and the attitudes of commission members on, its orders, such information is now being given. Commission members questioned on the subject believe this practice will go far in promoting a disposition for a more judicious handling of cases.

NEW FTC OBJECTIVES

WITH Administration support there is a strong movement in the Federal Trade Commission to put to an end the earlier practice of singling out individual companies on the basis of complaints by single competitors. Under that practice one company might be investigated and prohibited from following a particular practice, leaving competitors to go their way until FTC finally got around to examining their practices. Critics point out that such company-by-company procedure had the effect of creating bitterness on the part of the particular defendant and a cynical disregard on the part of its competitors.

The new objectives of FTC would end such practice and substitute investigations on an industry-wide basis. It is intended that such general studies will be followed by invitations by FTC to members of an industry to participate in a fair trade conference. Purpose of the meeting is not to ferret out culprits but to ask the industry to formulate an agreement as to what practice should be and should not be followed. FTC officials say these objectives have been widely approved by individual companies and trade associations.

FPC LOOKS AT CHEMICALS

FEDERAL Power Commission engineers have done a small amount of exploratory work with a view to making a new survey of power requirements in the electrochemical, electrometallurgical and allied industries. The previous study of the subject was reported in 1938. It is contemplated that a revision of the earlier survey will include new chapters on zinc, copper, magnesium, sodium, ferro-alloys, caustic and chlorine, calcium carbide, carbon and graphitic products, ammonia, potash and phosphorus. FPC's Power Requirements Section has a nucleus staff to do the job but is handicapped by lack of funds needed for a nation-wide study.

BETTER BOXES FOR BUTYL

MOVEMENT of raw butyl rubber from the butyl plants to consumers often has been seriously impeded by inadequate supply of specially coated cardboard containers. The Office of Rubber Reserve is working on the problem from several angles in cooperation with private industry. A possible solution lies in important development work, now under way, which is directed to the production of a polymerized hydrocarbon wrapper for the raw rubber which will prevent adhesion between the material and the container. This would permit unpackaging the rubber with less difficulty. A possible alternative to boxes is the use of coated paper bags, now used successfully for shipment of general-purpose synthetic rubber. The use of such bags in conjunction with the hydrocarbon wrappers is being investigated.

One of the two butyl producers recently had to curtail output by about 150 tons over a week-end because of lack of containers. Rubber Reserve officials say their efforts to interest a wider number of manufacturers in making the special boxes haven't been too successful. One reason is the general shortage of paper containers. Another reason is understood to be the desire of manufacturers to concentrate on conventional types of boxes on the supposition that the butyl business may be ephemeral. With this view, Rubber Reserve men strongly disagree.

GERMAN SCIENTISTS

EMPLOYMENT in industry of German scientists and engineers is still some time off, according to all indications last month. The War, Navy and State Departments joined in a statement saying that for the time being these aliens will continue to be monopolized for military work. It is declared that "upon completion of their work for the Army and Navy they will be available to American industry through auspices of the Department of Commerce after a thorough screening and investigation to determine their eligibility for status under immigration laws." Over 200 aliens are here now and more on the way.

STUDENT EXCHANGE PLAN

NEW arrangements for sending students and members of faculties abroad are being made through the State Department. It has authority under the Fulbright Act to make such economic, technical and cultural arrangements abroad as relate to any phase of educational programs.

It has been suggested that this plan may even be extended to a point of interest to industry. Competent persons from this

As the white outline indicates, a standard unit of nearly twice the frame size would be required to do the work of Speedaire.

Even in dust and grime SPEEDAIRE does the job

DRIVING doctor rolls on starch dehydrating machines in a Chicago plant, the Speedaires shown above give their owner these three benefits:

1. **A money saving of $39 on each Speedaire drive, compared to conventional worm-gear reducers.**
2. **With space at a premium, compact Speedaire proved ideal for this application.**
3. **In spite of dust and grime that accompanies this manufacturing operation, Speedaire continues to perform at full efficiency.**

Speedaire is Cleveland's new, powerful, fan-cooled, worm-gear speed reducer. Because it is fan-cooled it will do more work—and deliver up to *double the horsepower* of standard worm units of equal frame size, at usual motor speeds. Speedaire can be installed economically on many applications where other types have been used heretofore—giving you the advantages of a compact right-angle drive. Speedaire gives the long, trouble-free service characteristic of all Cleveland units.

Catalog 300 gives a full description of Speedaire—enables you quickly to figure proper sizes for your equipment. Send for your copy. The Cleveland Worm & Gear Company, 3273 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

country may be qualified to go abroad for extended periods both to give and to gain training. By this means it is possible, though not yet formally arranged, that a measure of American industrial friendship abroad may be stimulated for U. S. firms and industries.

NITROGEN PLANS CHANGE

War Assets Administration has had to revise its plans for nitrogen plant disposal for a variety of reasons. Most important has been the decision to have the War Department remove from the surplus list at least four of the six plants which were formerly being offered for lease or sale by WAA. These are: Missouri Ordnance Works, Cactus Arsenal, the West Henderson plant, and the Morgantown works of DuPont, although the last named never actually formally reached the surplus list.

Rather more surprising was the change in disposal plans for the nitrogen fixation plant at Lake Charles, La. WAA announced that it had been leased to Hercules Powder, only later to find that negotiations collapsed and a new plan of disposal to Mathieson Alkali was more attractive to the government. This and a number of other changes in negotiations just before final settlement is making WAA quite wary of announcement until everything is "signed, sealed and delivered."

RESEARCH CONTRACTS BEGIN

Contracting for research by Commerce Department's Office of Technical Services began with the tentative approval by its Advisory Committee of two projects. These relate to an agricultural fiber investigation and certain research on powder metallurgy. The first project is to be a contract with one of the state agriculture experiment stations with USDA cooperation. The other contract is being arranged with one of the outstanding technical colleges.

Officials of IRDD who handle these matters say that a very large number of suggestions have come to the Department. Even by September first there were a dozen of sufficient interest that they were given project numbers. Many more equally attractive proposals came in during September. Not nearly all of these can become contracts because the total sum available is only $1,000,000. It seems likely that this fund will provide for not more than 25 or 30 independent arrangements, though as many as 50 may be included if smaller individual commitments are decided on. Most of the original proposals have contemplated from $20,000 to $30,000 each; and some of them have asked for larger sums.

The initial plan contemplates making commitments for six-month intervals with the expectation of renewal and continuance over several years when real progress and further promise are shown. The Department wishes, however, to have definite results of some industry significance obtained within six months, as the funds are definitely not intended for long-term fundamental investigations. Practical results for early application are wanted.

Those wishing to apply for contracts should learn as to the information required, by getting a new pamphlet of instructions from Industrial Research & Development Division, Office of Technical Services, Department of Commerce, Washington 25, D. C.

MOBILIZATION PLAN SHAPING

The broad outlines of an industrial mobilization plan, intended to put the nation quickly on a war footing if and when necessary, are taking shape in Washington. They have marked significance for management and technologists. Reconversion will not reach a point where the basic industries can, even for a few years, forget about war. Their plans and operations will be so geared as to effect a quick change from peace to conflict, and it is likely that new legislation will reach Congress next spring to insure this condition, while at the same time providing a balance between the military and civilian elements in the picture.

Currently, stockpiling and the determination of what government-owned war plants will be kept on a standby basis press for attention. In Washington the Army and Navy Munitions Board is laying in stocks partly by acquisitions of surpluses from War Assets, and partly by purchases in the market, to the extent authorized by CPA. Donald Nelson, called to Washington by Truman, is looking over the war plants. War Assets has already attached "strings" to disposal of certain "basic" synthetic rubber plants, and will probably adopt the same policy with respect to other plants.

TREASURY BUYING MATERIALS

Information on identities, inventories and rates of acquisition of strategic and critical materials being stockpiled at various points over the country is not being disclosed in Washington by the agencies engaged in the work. Officials declare a lid has been clamped on such information in order to minimize effects on the market and to avoid disclosure abroad of the progress which the government is making in securing stocks of essential materials. It has been disclosed that within about five years the objective is to secure about $2.1 billion worth of stocks by transfer from surpluses held by War Assets and by purchase. It is understood that "a fraction" of the $100 million available for buying for the stockpile in this fiscal year has been expended.

The Procurement Division of the Treasury is accepting bids, following requests from the Army and Navy Munitions Board, for materials from an approved list of suppliers. Companies interested in these procurements are advised to write the Strategic and Critical Materials Division, attention Capt. Harry C. Maull, Jr., Treasury Procurement Office, 7th & D St., S. W., Washington 25, D. C.

STRATEGIC-CRITICAL LIST

An indication of what materials are of current interest in the stockpile program is afforded by the list of commodities issued a few weeks ago (Regulation 17) by War Assets as being in the strategic and critical category. Chemicals and allied products and metals in the tabulation, which is subject to revision from time to time, include aluminum, antimony, asbestos, barite, bauxite, beryl, bismuth, cadmium, castor oil, celestite, chromite, cobalt, coconut oil, columbite, copper, corundum, cryolite, fluorspar, graphite, iodine, kyanite, lead, magnesium, manganese, mercury, mica, molybdenum, nickel, palm oil, iridium, sodium, palladium, platinum, rhodium, ruthenium, pyrethrum, quebracho, quinidine, quinine, rapeseed oil, natural rubber, selenium, shellac, sperm oil, talc, tantalite, tin, tung oil, tungsten, vanadium, zinc and zirconium ores.

Civilian Production Administration completed last month its estimates of civilian requirements for the 12-month period beginning August 1. The list, filed with RFC and the Army and Navy Munitions Board, was not disclosed. Subject to revision, the list will indicate the extent to which commodities are available for stockpiling.

NEW LEGISLATION IMPENDS

Administration-backed legislative proposals are looked for next year as a means of putting into effect the long-range phases of the industrial mobilization program, the fundamental architecture of which is centered in the Army and Navy Munitions Board. There are fair prospects for "educational" munitions contracts for industry, the establishment of facilities in plants for trial runs in the production of newly developed war products from time to time, and the maintenance of nuclei of technologists trained to instruct others and assist in quick conversion of plants in the event of emergency. Costs of these operations to industry are expected to be largely footed by the government.

Influential administration advisers are known to favor legislation to set up a permanent civilian agency, independent of ANMB, to act somewhat as a peacetime

YOU may never see the Columbia Trade-mark on any finished product you buy, but more likely than not, Chlorine or Alkalies, or some of the other related products that Columbia produces, were used somewhere along the line of its manufacture. Columbia Chemicals are essential to many things—as ingredients—as aids to bringing about chemical reactions—or in the treatment of materials to change or improve their characteristics. So widespread has become the use of Columbia Chemicals, that today there is scarcely an industry that does not depend on them to make products better—more lasting—more useful.

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Soda Ash · Caustic Soda · Liquid Chlorine · Sodium Bicarbonate · Pittchlor (Calcium Hypochlorite) · Silene EF (Hydrated Calcium Silicate) · Calcium Chloride · Soda Briquettes · Caustic Ash · Phosflake · Calcene T (Precipitated Calcium Carbonate) · Modified Sodas.

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WPB in the guidance of the mobilization program and assure civilian control of it. This agency would maintain close contact with ANMB and industry. One important problem which it would face is the question of the concentration of productive capacity in the Atomic Age. This is obviously also a matter of concern to companies contemplating new construction.

EFFICIENCY GAGE NEEDED

THE productivity studies being conducted by the Bureau of Labor Statistics are expected to be of great interest to executives, plant engineers and workers. The initial reports in this program will cover the period 1939 through 1945. Subsequent reports will be on an annual basis. Collected directly from industry for one specific purpose, the data are such as to furnish a better understanding than has been available in the past on what has happened, what is happening and what seems likely to happen in productivity in the chemical and other manufacturing industries.

With labor being at present an increasing element in manufacturing costs, the need for securing more precise and more informative facts about productivity is generally recognized. Labor Department officials beleieve that the statistics being collected under the new program will furnish the management of a given company an indication of how well the efficiency of that organization is keeping step with other similar groups and spur its technologists to introduce means of controlling costs in the face of advancing labor rates. It is also believed that the information will be of va'ue both to labor and management in the discussion of wage changes.

PRODUCTIVITY STUDY BEGINS

HAVING conferred last month with government agencies involved in the collection of chemical statistics, and with representatives of the chemical industries, the Bureau of Labor Statistics is rounding out its plans to examine man-hour productivity in the manufacture of representative chemicals. Late last month a tentative list of organic and inorganic chemicals was selected for this study. Under this program, which is aimed to include all principal lines of manufacturing, the bureau is attempting for the first time to ascertain productivity in terms of individual products. Formerly the bureau's studies have been pitched on an overall industry basis and predicated on data, such as the Census of Manufactures, which did not indicate causes for changes in productivity.

In selecting the particular chemicals the bureau is using two principal tests: (1) their relative importance in the chemical field; (2) the extent to which processes used in their manufacture are fairly representative of other chemicals. Reporting manufacturers will be asked to point out reasons for material changes in productivity, such as changes in methods, equipment, specifications and seasonal regularity of operations. Such information has not hitherto been available. An additional feature is that the returns are intended to disclose the effect on productivity of such factors as size of plant and geographic location. Bureau officials plan by the end of this year to send out field men to acquaint companies with the objectives of the survey and secure their agreement to file returns.

REVISING CHEMICAL DATA

DEVELOPMENTS in chemical processing industries during and since the war are being examined by the Interdepartmental Chemical Statistics Committee in Washington. This group has had several recent meetings to discuss possible need for changes in the reporting forms on which are based monthly production statistics issued by the Census Bureau and the Tariff Commission. The present forms will be used for the rest of this year, but some changes may be made early in 1947. Suggested revisions will receive the attention of the industries, the Budget Bureau and the agencies collecting the statistics.

Three broad considerations govern the choice of chemicals to be included in the monthly reports: (1) economic importance in total chemical manufactures; (2) their importance as materials used in the production of finished chemicals; (3) their variability during the year with respect to monthly output.

The Interdepartmental Committee is examining chemical developments of recent years. Some members are particularly interested in the growth of acetylene chemistry, new plastics and the potentialities of hydrocarbon chemicals from petroleum refining. Committee members hope to keep the monthly reports abreast of commercial advances.

SURVEY OF ENGINEERS

COMPREHENSIVE information on earnings, distribution by industry, and changes in locality of occupation of members of the engineering societies in the period 1939-1946 is being collected by the Bureau of Labor Statistics in cooperation with the Engineers Joint Council. Questionnaires are being sent out to the 90,000 members of the societies, which include the American Institute of Chemical Engineers. Replies must be filed by November 15.

The returns are expected to serve a number of purposes. They will acquaint practicing engineers with the prevailing incomes in their lines of work, furnish employers a basis for judging what are average salary schedules, give the engineering societies information on how their respective members fare with respect to other groups, and furnish the engineering departments of educational institutions with data on what incomes their students may reasonably expect. The value of the survey depends, of course, upon the extent to which society members cooperate.

DEFERMENT LIST MAY WIDEN

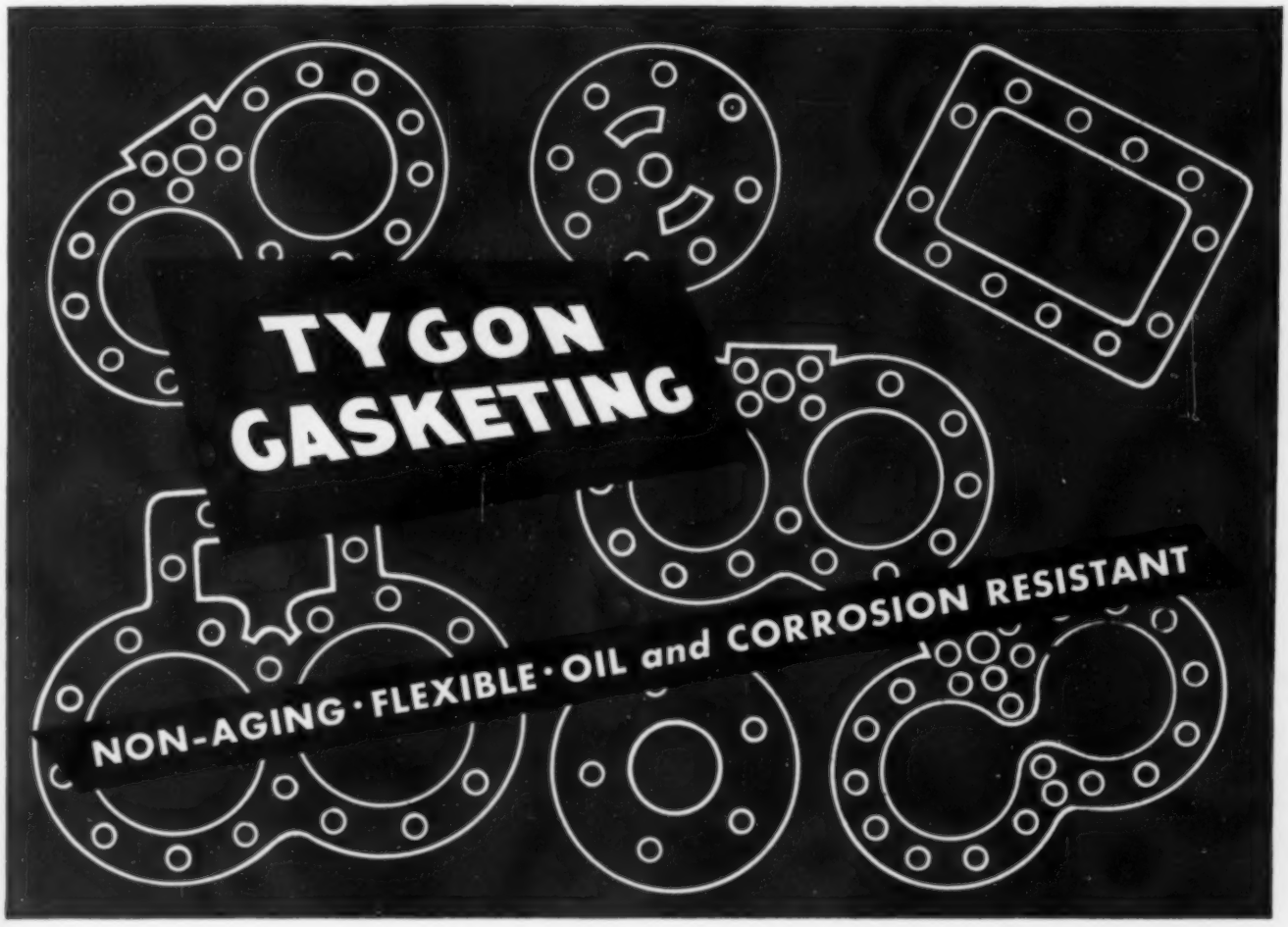
INCLUSION of more chemicals in the "critical" list of materials used as a basis for certification of applications for draft deferments of production workers was being considered a few weeks ago by CPA. Officials in that agency reported that only about 10 percent of the certifications was for men in the chemical industries, and this percentage consisted almost entirely of supervisory, technical and scientific men. Widening of the list would open the way to deferment of more production workers. Under consideration for inclusion in the list were alkalis, anhydrous ammonia, chlorine and coke. Previously, a change had been made to include all types of rubber instead of only butyl. Approximately 75 percent of the total applications handled by CPA have received endorsement.

OSRD has likewise been able to certify about 80 percent of the applications filed with that agency for deferment of advanced students and research men. A fairly large percentage of these are for chemical workers. Neither CPA nor OSRD have been officially limited to a fixed number of certifications they may issue, but officials of both agencies say they are staying strictly within the prescribed criteria in passing on each case.

WORLD FERTILIZER PICTURE

FOOD and Agriculture Organization of the United Nations has prepared the first comprehensive postwar report on the production and requirements for nitrogen, potash, and phosphate for the entire world. Prepared last spring, its Technical Supplement No. 7 to the "Report On World Food Situation" has been released to present this comprehensive world picture of the fertilizer problem. Included as probably the most important feature is a preliminary forecast of the 1946-47 production and requirements country by country.

This particular summary will have greater or lesser practical meaning according to the way in which this government takes part in fertilizer chemical management. If it sits back and lets FAO furnish the basis for allocation of these materials for the United States as well as the rest of the world, then this FAO report may become the bible of fertilizer chemicals. If Washington decides that CPA is going to govern nitrogen, potash,



WHEREVER you have a gasketing problem in handling corrosive liquids or gases, you may find an effective solution through the use of Tygon gasketing.

This unique rubber-like plastic is resistant to almost all acids, alkalies, fresh or salt water, oils, greases, or gasolines. Even in handling certain solvents to which Tygon is not resistant, the swelling action caused by the solvent often adds to Tygon's effectiveness as a sealing material.

In addition to its ability to resist corrosives, Tygon Gasketing materials are characterized by other important advantages:

1. **Non-aging**—Tygon shows no deterioration with age
2. **Flexible and elastic**—Tygon has a flexlife 10-12 times that of rubber
3. **Tough, strong, and durable**—Tygon outwears the finest leather 2 to 1
4. **Non-toxic, tasteless, odorless**—Tygon is non-contaminating to solutions

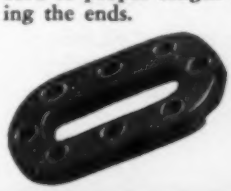
●

May we suggest that you send us detail and assembly prints for analysis? We will then offer our suggestions, and samples of Tygon formulations best suited for your needs. Write today to: The U. S. Stoneware Co., Akron 9, Ohio.

Ways to Use Tygon Gasketing

Sheet Stocks—Tygon Gasketing is available in the calendered sheets 27" by any length by .008" to ⅛" thick or in press polished sheets 20" x 20" x 1/16", ⅛", 3/16" or ¼" thick; in the form of tape ¾" wide by .012" thick by any length from which flat gaskets may be died out.

Tubing—Tygon Tubing or Solid Cord is available in diameters up to 1¼" O.D. from which bushings, sleeves, bumpers, small ring gaskets, etc. may be cut. Larger ring gaskets may be made by cutting tubing or cord to proper length and heat sealing the ends.



Molded Gaskets—Grommets, seals, extruded strip or channel in various cross sectional shapes may be furnished on special order either from standard or modified Tygon formulations.

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Since 1865 • Akron, Ohio

TYGON TANK LININGS AND GASKETING MATERIALS • TYGON SHEETINGS FOR SURGICAL AND HOSPITAL USE • TYGON FLEXIBLE TUBING
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and phosphate, then some larger attention to domestic needs and wishes may be expected.

Obviously American industry would prefer decisions by CPA rather than FAO. But one does not hear much protestation to that effect. Apparently industry executives are still reluctant to oppose the international program, probably until they know whether or not President Truman is going all out for internationalism. No matter what the administration program affecting these commodities may be, the FAO report clearly demonstrates a world shortage of all three major fertilizer components.

OFFICE OF PUERTO RICO

THE INSULAR government of Puerto Rico has opened offices in Washington to facilitate doing business not only with the government of the United States but also with American industry interested in any feature of Puerto Rican activity. Chemical engineers and executives may find this new office able to help them when they have any business dealings in the territory. Inquiries can be addressed to Office of Puerto Rico, 1026—17th St., N. W., Washington 6, D. C.

But inquiries regarding the development of new enterprise requiring technical and economic interpretation can better be addressed to Puerto Rico Development Co in New York. That agency represents the insular government in an effort to get American firms to establish new or branch factories on the Island. It conducts various field investigations and works with firms having prospective interest in such new enterprise.

The Office of Puerto Rico in Washington, on the other hand, is better able to direct American inquirers to the official agencies in the Island with which one must deal if he has any specific problem demanding governmental action. It is also able to assist with general statistical information where technologic problems are not involved. If one happens to address the wrong one of the two agencies initially, he will quickly be set right as they cooperate actively at all times.

ICC REGULATIONS AMENDED

INCLUSION of a large number of organic peroxides by name (formerly they were in one of the basket clauses), approval of the 1D carboy for carrying flammable liquids with flash point below 20 deg., and authorization for use of solid nickel tank cars in the shipment of phosphorus oxychloride and phosphorus trichloride represent the principal features of amendments to the ICC regulations for transportation of chemicals. These and other amendments were included in a notice dated September 18 on Docket No. 3666. Objections to the proposed amendments were to be received by the Commission until October 8. It was not expected that hearings would be held, unless objections made it desirable to permit more elaborate public discussion of the questions. Formal issuance of the ICC order was expected for late October or early November unless protracted hearings should be necessary.

RAW MATERIALS FOR ALCOHOL

ALLOCATION of corn to butyl alcohol producers has been authorized by the Department of Agriculture on a continuing basis so that the full capacity of the three grain plants may be utilized. Molasses will be used to the extent that it is available, and the remainder of the plant capacity will be operated on corn, if developments materialize as expected. Agriculture has specifically forbidden use of wheat, however. Use of corn for ethyl alcohol had not started in mid-September, although supplies probably will be allocated to this use during the fall. Potatoes still are plentiful and are being used at some of the fermentation plants. Use of malt with potatoes is limited, however, to 4 percent of the weight of fresh potatoes or 16 per cent of the weight of dehydrated potatoes, by the grain allocation unit of the Department of Agriculture.

SCIENTISTS FOR DOWN UNDER

THE Australian Embassy in Washington, through its Scientific Liaison Office, is trying to find research scientists in this country and Canada who will accept research or teaching positions in Australia. The Australian Council for Scientific and Industrial Research is operating large well-equipped laboratories of widely varying nature. It requires numerous research leaders to plan and direct the work for which annual appropriations approximating $10,000,000 are currently available.

New programs to be organized shortly will deal with concrete, textiles, ceramics, physics, metallurgy, and a number of other process-industry subjects of interest to chemical engineers. The Scientific Liaison Office of the Australian Embassy in Washington will welcome inquiries from promising graduate students, professors, and industrial research workers who might be interested in taking positions in Australia for a period of years.

MINOR NEWS GLIMPSES

Transfer of some residual CPA controls to other agencies is being discussed in Washington in view of the approaching end of CPA's life. CPA spokesmen say there probably will have to be some measure of continued control over tin, lead and lead chemicals, antimony, alcohol, potash and rubber. There are indications of a bit of intergovernmental rivalry to secure such functions.

New general rules, including rules of practice and procedure, of the federal power commission have been issued. The new regulations are a thorough revision of former ones and embody procedural changes required to become effective under the administrative procedure act. A number of alterations relate to the natural gas act.

Continued development of the Department of Commerce's growing interests in promotion of science and technology is expected under the new secretary, Mr. Harriman. Department officials who regret the departure of Mr. Wallace feel that their new boss will adhere to the general policies of their former chief with respect to those interests.

A mine of information about the organization and procedures of the cabinet offices and independent agencies and commissions is contained in the Federal Register of September 11. The compilation is of importance to executives of trade and industry subject to federal regulation. Throwing the light of day into the recesses of the federal structure was brought about by the administrative procedure and passed last June by congressman wanting to arm the public with information, define limits on administrative powers and outline conditions of judicial review.

Possibility of government control over commercial exports and imports even in peacetime is being talked in Washington as a development if administration efforts to bring about greater freedom in international trade do not succeed. Politically unpopular now, the idea may gain ground as a measure to use trade as a diplomatic tool if foreign groups refuse to open blocked areas abroad and will not play commercial ball with the United States.

Keeping of records which were required under O.P.A. before that agency had many of its powers curtailed, is still required. Executives of process industries must remember that such old records must be kept until July of next year even though no present or prospective use for them appears likely.

Boosting of freight rates has been delayed by the Interstate Commerce Commission. This was not done by any formal action, but was very effectively accomplished when the Commission set a long slow schedule for completeing its review of the railroads' request for a 25 percent freight rate boost. It is now evident that the carriers will get no decision that is effective before Christmas, and it may be much later than that.

CHEMICAL ENGINEERING

WITH CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902 OCTOBER 1946 SIDNEY D. KIRKPATRICK, Editor

Headaches and Hangovers

"THERE'S nothing wrong with our business that full-scale, well-sustained production won't cure, but . . ." Thus begins the sad story we've heard all too frequently from chemical manufacturers during the past few weeks. Suppose we list a few of the "buts" that seem to be most prevalent among the business men we interviewed during the Chicago Chem Show and on two subsequent trips to New York State and New England:

1. Labor problems were first in nearly everybody's list. A number of chemical plants are down because of strikes, while others are threatened by demands for a second round of wage increases. There are distinct shortages of skilled workers, especially in the East where in one city we found four firms that could each use one hundred to five hundred more employees. But the most common complaint was on the score of low productivity—the appalling lack of any desire to deliver an honest day's work.

2. "We can't get supplies." In a number of lines of industry raw material inventories are exhausted or so badly unbalanced as to retard production. Alcohol plants are shut down for lack of molasses. Glass plant managers complain that they can't get soda ash, litharge, even borax and boric acid. An equipment manufacturer told us that he must wait twenty to twenty-four months for fractional horsepower motors, six months for gears and malleable castings, even eight weeks for his gaskets. Part of this lack of balance may be due to arbitrary price controls, but in many cases it traces back to upsets in wage-cost relationships.

3. New production and reconversion projects are held up because of inability to build plants. Industrial construction costs are up to 160 percent of prewar, and even that is purely a hypothetical figure in many localities. Contractors report exorbitant demands from labor leaders who give no guarantees that workers won't be taken off the job by the next highest bidder.

4. "Transportation is worse than in wartime." Everyone wants to know where all the boxcars went. Manufacturers are still being charged heavy demurrage when incoming shipments can't be promptly unloaded into already bulging warehouses. But in other places finished goods in great demand are being kept from the market because of what appears to be a national breakdown of rail and trucking facilities.

5. The need for new housing in some communities is so great that manufacturers have had to return to wartime expediencies in conveying some workers over twenty miles from home to plant. This is costly in time and effort; it also increases already high rates of absenteeism.

6. On top of all these current worries is the evident concern about the August-September break in the stock market. Does it forecast another 1929-32 depression? Or are we in for a business recession during the next six to twelve months comparable with the declines in 1919-21 or 1937-8? If so, when will it occur, and for what duration? We don't pretend to know the answers, of course, but it certainly seems to us that the postwar recovery cycle still has a long way to go to supply deferred demands in addition to normal needs.

If this is the case and if enough people realize that our present problems are only temporary deterrents, we can be sure that the forward movement of business will continue without any very serious interruption. But in any event management has a tough job ahead. It calls for the same sort of initiative, flexibility and resourcefulness that made it possible to lick even tougher problems of war production. We are optimistic enough to believe that chemical management will soon throw off some of these minor headaches and wartime hangovers in time to tackle in earnest the greater problem of balancing peacetime production.

Final stage of deep fermentation takes place in these huge vessels; after fermentation is carried out under aseptic conditions with all process variables carefully controlled, final concentration of streptomycin is approximately 0.005 percent

STREPTOMYCIN

Engineered Into Commercial Production

RICHARD W. PORTER

Assistant Editor, Chemical Engineering

From original discovery to mass production within three years is a noteworthy accomplishment in any industry. But in the field of pharmaceuticals, where medical evaluation alone often takes years, this is indeed an achievement. Pushed to completion in record time, Merck's $3,500,000 plant is now turning out more than 100,000 grams of streptomycin per month by submerged fermentation, then extraction. For a clear idea of the complete process, from raw materials to finished product, turn to the pictured flowsheet shown on pages 142-145. — *Editors*

HARD on the heels of sulfa and penicillin, a new "wonder drug" is ready to take its place in fighting man's most insidious enemies. Now in large scale production, streptomycin was responsible for saving many lives during the closing months of the war and is proving equally vital in peace.

In contrast to many important discoveries, streptomycin resulted from a carefully planned, systematic search for an antibiotic effective against gram-negative organisms (penicillin acts against gram-positive organisms). First reported by Dr. Selman A. Waksman of Rutgers University in 1944, this pure white powder, produced by certain strains of *Streptomyces griseus*, soon captured the attention of medical men the country over. Within a few short months clinical tests confirmed the belief that streptomycin would fill another gap in the front line of medical achievement.

Recognizing the possibilities of streptomycin and spurred on by war necessity, Merck & Co., Inc., whose researchers had already been carrying on studies similar to, and in conjunction with, those of Waksman, quickly seized upon the problems of (1) proving the chemotheraputic value of this new antibiotic, (2) obtaining necessary WPB authorization and priorities for plant construction and (3) getting into production.

Spearheading the attack, with success measured in terms of human lives, the task was begun by supplying samples of the drug to researchers throughout the country. Not until June 1945, when these research men assembled at Rahway, was it firmly established that streptomycin could effectively combat such diseases as tularemia (rabbit fever), influenzal meningitis and gram-negative urinary tract infections. (More recent research confirms that this drug is an adjunct in the treatment of certain types of tuberculosis.) Two months later on the strength of recommendations by Army & Navy doctors, WPB granted priorities for plant construction to Merck and several other manufacturers.

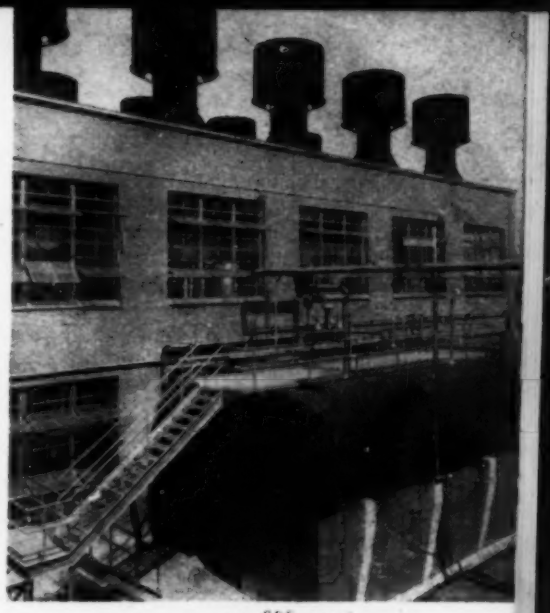
OUTLINE OF STREPTOMYCIN PROCESS

1. Inoculation and submerged fermentation of an aqueous nutrient medium with *Streptomyces griseus*. Final fermented broth contains 0.005 percent streptomycin.

2. Recovery of crude streptomycin by successive operations of filtration, carbon adsorption, elution, evaporation, precipitation and drying.

3. Purification by complex reactions to remove toxic compounds and other impurities.

4. Finishing in a super sterile area by high vacuum sublimation, milling, weighing into vials, and packaging.



One of the large buildings in which more than 50,000 tons of material (including solvents) are processed to obtain a monthly production of less than 250 lb. of finished product

Long experienced in engineering the production of fine chemicals, including penicillin, Merck was first to achieve large scale production. Similar to other wartime projects, this was fraught with many difficulties. Plans were made and construction started before process details were worked out. Research and pilot plant studies, proceeding simultaneously, managed to keep a precarious lead by a sometimes much too narrow margin. All the resourcefulness and ingenuity of its organization of scientists and engineers was required to accomplish the task.

On top of this, the transition from war to peace added to the difficulties of material and equipment shortages. With many industries slumping badly, or even at a complete standstill, it was next to impossible to obtain urgently needed materials. Nevertheless, with the cooperation of many suppliers it was possible to achieve the seemingly impossible.

Costing some $3,500,000 and housed in four complete buildings (three at Elkton, Va., and one at Rahway, N. J.) the plant is now turning out over 100,000 grams* of streptomycin per month and is not yet up to its ultimate capacity. Considering that just a year ago production was only 3,000 grams per month, this new capacity, in terms of number of patients treated, means much to medical therapy.

Seldom, except in the field of fine chemicals does one find so much material processed for so small a final yield. Processing some 50,000 tons of raw material (including solvents which are recovered) and using about 45,000,000 gal. of process water, total monthly production of finished dry powder is less than 250 lb.

* Potency of streptomycin was expressed originally in terms of the S unit, arbitrarily defined by Waksman as that amount of the antibiotic which when present in 1 ml. of nutrient medium will just inhibit the growth of a given strain of *E. coli*. However, the Food & Drug Administration recommends that streptomycin be referred to in terms of weight of pure streptomycin base, 1 gram of streptomycin base being equivalent to 1,000,000 S units. The S unit is applicable only to streptomycin. It is not related to the unit of any other drug on the basis of either weight or biological activity.

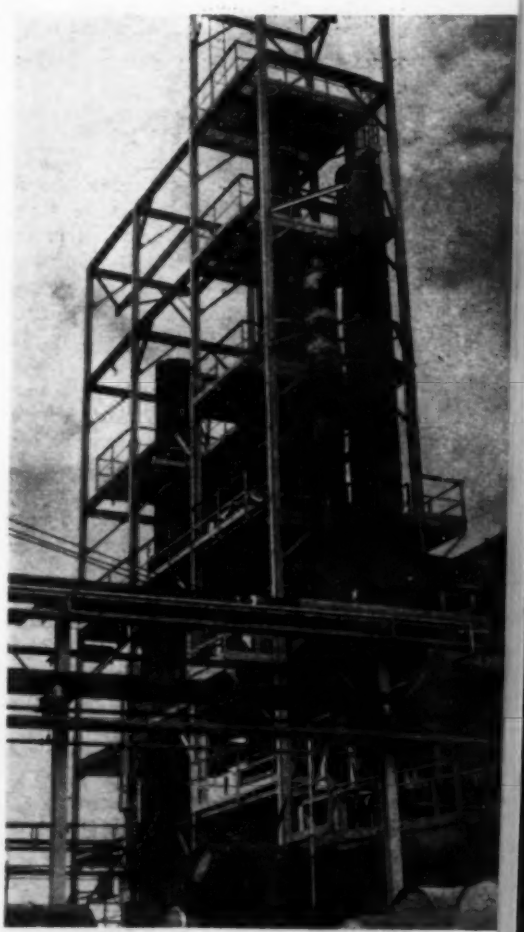
Manufacture of streptomycin consists of four main processes: fermentation, recovery,, purification, and finishing. The first three of these take place at the Virginia plant, while the purified concentrate is shipped to Rahway for finishing.

Original mash for fermentation consists of a dilute aqueous solution containing about 1 percent glucose, 0.5 percent peptone, 0.5 percent meat extract, and 0.5 percent ordinary salt. Composition of medium for the production of streptomycin is extremely critical. Streptomycin formation depends largely on the presence of meat extract, and although corn-steep liquor may be substituted, it complicates the subsequent recovery and purification processes. However, starch and glycerol may be used in place of glucose, while casein, tryptone, amino acids and sodium nitrate can be substituted for peptone.

THE PROCESS

Raw materials of the nutrient medium are mixed with water in a concentration about ten times that finally required and stored until needed. After being pumped to the fermenters and properly diluted the mash is sterilized by heating at approximately 120 deg. C. and then cooled before being inoculated, since *Streptomyces griseus* is destroyed or inactivated at such temperatures. After inoculation the fermentation takes place at the optimum temperature of 25 to 30 deg. C.

Complete sterility is absolutely necessary and utmost precautions are taken to prevent any contamination. Hence, the whole fermenter operation must be carried on aseptically (in the absence of any other micro-organisms), to prevent contamination which might inhibit the formation of streptomycin or cause formation of substances that would add to the difficulties of purification and recovery. For this reason it is considered necessary to have all joints and connections to the fermenter protected by steam seals. Valves are steam sealed and all pipelines leading into the fermenter



Distillation columns are employed to recover the large volumes of various solvents used to accomplish the extraction and purification of streptomycin from the dilute fermentation broth

are kept under steam pressure when not actually in use.

Original cultures provided by Waksman, are maintained by Merck's micro biological laboratory. Isolations from the culture are tested and only the most active strains are used for commercial production. Spores of the most active strains are inoculated on sterile earth or soil and stored in test tubes under refrigeration. These sterile soil cultures of *Streptomyces griseus* provide the seeds for commercial production of streptomycin.

An agar slant inoculated with about 0.1 gram of this sterile culture is incubated under carefully controlled conditions in the laboratory. It is then emulsified with distilled water, divided into three parts, each of which is transferred to a flask containing about 300 cc. of nutrient solution. Deep or submerged fermentation starts here. Since *Streptomyces griseus* is an aerobic organism it requires air for growth which is here supplied by shaking the flask mechanically. pH must be kept about neutral at the beginning, changing to a slightly alkaline reaction at the end of fermentation. Up to this point the process has taken place completely in the laboratory. Now, however, the flask culture becomes the starting point for mass production in the plant.

FERMENTATION

Four sizes of vessels constructed of ordinary carbon steel are employed in the fermentation process. Each vessel in the series was designed so that it would provide the required amount of growing organisms or inoculant for the efficient utilization of the next larger fermenter in the series.

In this manner it is possible to achieve maximum production of streptomycin per hour per gallon of fermenter capacity. Not counting preparation of the flask culture, fermentation then is actually a four-stage operation, each stage being operated under essentially the same conditions. After inoculation, fermentation in each vessel continues until the optimum amount of fermentation is achieved. Total fermentation time of all four vessels in a series amounts to several days, although each stage of fermentation follows its own particular time schedule. The number of vessels of each size, however, is such that maximum fermenter capacity is always in operation.

During fermentation, the temperature is carefully controlled at 25 to 30 deg. C. by cooling with water by means of jackets or built-in coils. Aeration is accomplished by sterilized air blown through the fermentation liquid. Approximately 0.03 cu.ft. of air per min. per gal. of fermenter capacity passes through the sterilizing filters to remove all airborne micro organisms and to maintain the aseptic conditions so important to this operation. CO_2 is formed during fermentation. Each vessel is equipped with an agitator to promote aeration.

One of the difficulties encountered is the tendency of the fermenting mash to foam. For this reason, it is necessary to keep the amount of air and agitation at the proper balance since too much air causes foaming, while too little inhibits bacterial growth. Where excess foaming takes place, a foam inhibitor is used. Just as everything else that enters the fermenter must be sterile, so must the foaming agent be sterilized.

Selection of anti-foam material posed another serious problem. The material must first be non-toxic to the organism and second must not interfere with subsequent steps in recovering and purification. Final selection was made after a great number of anti-foam substances had been tested.

After several days of fermentation the original minute quantity of soil culture attains maximum growth in the final large fermenter and a mere trace of streptomycin in the total 15,000 gal. of liquid has been produced. However, should any contamination occur, or any part of the process be allowed to vary from the rigid operating conditions required, even this trace of streptomycin might be lost. Any variations in temperature, pH, and rate of air flow cause serious difficulties. Microbial infection is the bugaboo and is guarded against with the utmost care. If contamination occurs the fermentation batch is discarded.

The 15,000 gal. fermenter charge containing large amounts of mycelium (mass of growth of these organisms) is pumped to an agitated surge tank from which it is drawn off continuously. Here begins the recovery process in which the traces of streptomycin in concentration of about 0.005 percent must be separated from the tremendous quantity of liquid in which it is dissolved. Although fermentation is a batch process, recovery operations are strictly continuous.

Recovery is accomplished in a series of five operations: (1) removal of mycelium by filtration, (2) extraction of streptomycin by adsorption on activated carbon, (3) elution of the streptomycin from the carbon adsorbate, (4) concentration of the eluate by evaporation and dehydration, (5) double solvent precipitation followed by filtration and drying. This results in a crude product containing about 25 percent streptomycin.

EXTRACTION

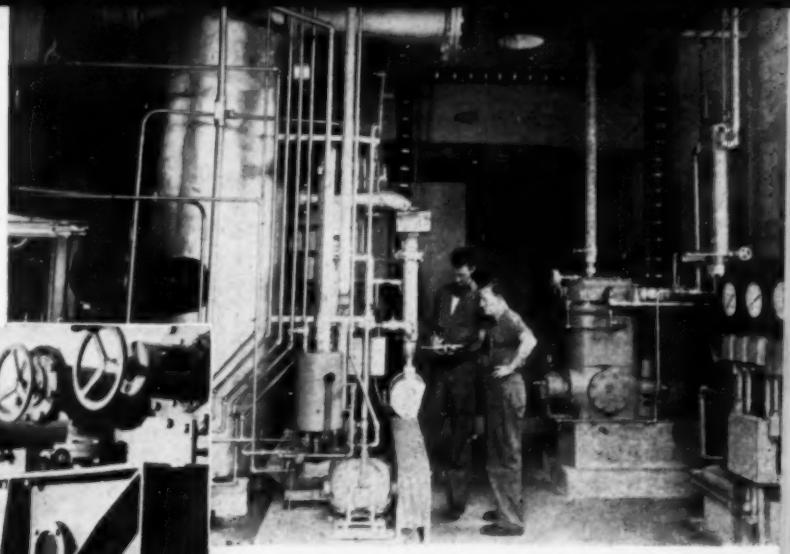
Practically all of the common methods for separating solids from liquids were studied and evaluated in an attempt to filter streptomycin solutions without loss of even minute quantities of this potent drug. Selection of a filter was important since the removal of mycelium from the broth presents a very difficult filtration problem. Finally chosen was a continuous pressure type filter. Most filtering operations throughout the process are accomplished in this type of equipment since it causes minimum loss of streptomycin by entrainment, allows high filtration rates, and causes smaller losses of volatile solvents than vacuum filters.

To carry out this separation a filter aid is used both as a precoat of the filter and as admixture in the broth. Selection of this filter aid required great care since many of the commercially available materials adsorb streptomycin. Filter aid is automatically proportioned according to the flow of liquor and is continuously mixed with the broth. After filtration the pH of the filtrate is carefully adjusted before passing through a second filter for final polishing. Filter cake from both filters is discarded. Final filtrate is checked for clarity by a meter utilizing a photoelectric cell.

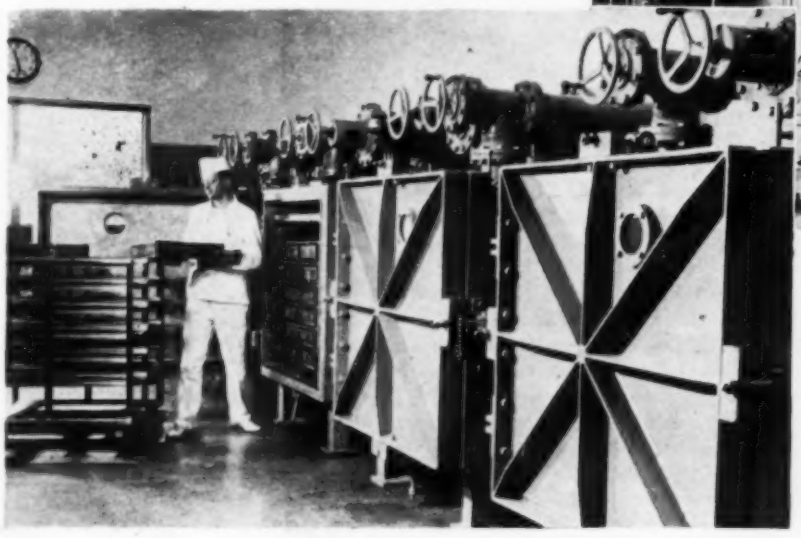
Clear filtered broth is then mixed with activated carbon which adsorbs streptomycin from the solution. It is filtered on a pressure filter and the carbon adsorbate cake is then washed with alcohol to remove impurities. The slurry is refiltered and the filtrate containing the solvent returned to the solvent recovery plant. Filtrate from the first carbon filter is evaporated in a quadruple effect evaporator

Over $200,000 worth of instruments measure and control process variables

Right—Vapor from the sublimation dryer is frozen at —80 deg. C., in this condenser and removed; McLeod gages measure dryer vacuum



Below—Dryers operating under high vacuum of less than 100 microns cause sublimation of the frozen concentrate leaving an easily powdered cake



before discharging to a waste disposal unit.

Adsorption takes place continously. Carbon is automatically proportioned to the liquor and thoroughly mixed by passing the slurry through a series of three agitated tanks before it is filtered. The carbon balance here is important since too little carbon results in streptomycin being lost in the broth, while too much causes loss by incomplete elution.

Streptomycin is removed from the carbon in a two-stage countercurrent elution process using acidified solvent such as HCl and alcohol. Streptomycin hydrochloride is formed here in solution while a large amount of impurities remain adsorbed on the carbon.

Equipment for elution is comprised of rubber lined elution tanks, porcelain pipe and fittings, Durichlor pumps, Hastelloy and rubber lined filters. Extreme care is taken to prevent the possibility of contamination by metallic salts formed by corrosion of equipment.

Up to this point each step in recovery operations has been primarily for the purpose of removing impurities but the dilute eluate is evaporated for the purpose of concentrating prior to precipitation of the crude product.

Rich acid eluate is neutralized and then concentrated by use of single-pass evaporators. The dilute aqueous solvent solution of streptomycin hydrochloride passes through a series of three evaporators operating under vacuum and at a relatively low temperature (60 deg. C. or less). Vapors are separated from the liquid and when condensed are pumped to the solvent recovery unit. Actually the third evaporator of the series acts as a dehydration unit. After dehydration, the concentrate contains about 25 percent solids of which less than one quarter is streptomycin.

Streptomycin in the concentrate is then precipitated by addition of another solvent. The precipitate of crude streptomycin is retained on a plate and frame filter press while the filtrate is returned to the solvent recovery unit. Crude streptomycin cake is then dried in a vacuum dryer. Containing about 25 percent streptomycin, the crude material is temporarily stored in drums while being assayed before purification.

Complex methods were developed to accomplish further purification. After being redissolved in a solvent, the crude material passes through a continuous process which eliminates the remaining impurities. Finally, the purified streptomycin is precipitated, filtered, and dried in a vacuum dryer. This material is then redissolved to form a concentrated solution which is then treated for the removal of pyrogens, histamine-like substances, and other materials that might interfere with its clinical use. Finally, it is passed through a biological filter and filled in stainless steel containers for shipment to the Rahway finishing plant. It is necessary here to carry out all operations under stringent aseptic conditions to prevent any contamination.

Finishing operations were brought to Rahway in keeping with the company policy to centralize all packaging operations and to co-ordinate all final quality controls prior to final distribution.

At Rahway the stainless steel containers of streptomycin solution are received in a specially designed, super sterile building where the utmost precautions are taken to insure a product of highest purity and unquestioned quality. It is here that the operations of blending, final bacterial filtration, freezing, drying by high vacuum sublimation, milling, weighing into vials, and packaging are carried out under conditions to insure sterility of the final product.

To maintain sterile conditions in the processing areas, scrub-up techniques worthy of a surgical operating room are imposed on all workers. A special training course was set up for the express purpose of teaching these techniques to the employees. Street attire is exchanged for sterile uniforms and shoes by all who enter the sterile areas. No one is allowed to violate the rules. All operations, however, can be viewed from an overhead corridor fitted with large plate glass windows. This, plus a loud speaker intercommunication system, provides adequate facilities for plant supervision.

SUPER STERILITY

The plant itself is "armed to the teeth" to prevent contamination of the sterile areas. All outside air entering the building must pass through sterilizing filters of the air conditioning system. As an added precaution, triethylene glycol is applied in the form of a fine mist. Air throughout the area is sampled and tested regularly by a bacteriologist to check sterility. Ultraviolet lamps are used as a final precaution in the cubicles where streptomycin is exposed to the atmosphere. In fact, no stone is left unturned to prevent contamination from any possible source.

Perhaps the most amazing aspect of this phase of operations is the system of accounting. Not unlike a bank, where all books must balance to the last penny at the end of the day, so much each last unit of streptomycin be similarly accounted for. If only a single vial is missing no one is allowed to leave the plant until it is accounted for. This is important, not so

much because of the money value but because each vial must retain its identity so that a given lot may set aside completely in case further tests uncover irregularities.

To balance the daily account several factors must be considered. These are as follows: (1) Material in process, (2) potency loss in drying, (3) actual physical loss in milling, (4) samples taken for assaying, and (5) washings. All washings are carefully saved, assayed and returned in bulk to Elkton for reprocessing.

Blended streptomycin concentrate from the shipping containers is first passed through a biological filter. Special filter disks retain all organisms and pyrogens. The filtrate is automatically metered into stainless steel trays which are placed in a freezing unit operating at a temperature of —40 deg. C. The trays containing the frozen concentrate are then placed in a high vacuum dryer where sublimation of the frozen water takes place, leaving a white cake of dry, sterile streptomycin hydrochloride which can be readily powdered.

FINAL OPERATIONS

Sublimation is carried out in a vacuum of less than 100 microns. Water vapors from the dryers pass to a condenser operating at —80 deg. C. The vapor collects on the condenser walls in the form of ice and is then scraped off and removed.

Ball mills reduce the dry cake to a fine powder before it is weighed and filled into sterile vials. This is accomplished in special cubicles safeguarded with ultraviolet light. After being capped and labeled the vials containing 1 gram of streptomycin are ready for final approval by the control laboratory prior to shipment. These final operations take place in special low humidity rooms maintained at 10 percent relative humidity to insure production of a fine dry powder. Storage of streptomycin under FDA regulation must be at temperature less than 15 deg. C. This is to insure against any possible loss of potency.

Until Merck went into full scale commercial production, all of the streptomycin available was allocated by CPA principally to meet urgent needs of the military. Since September 1 of this year, however, over 1600 hospital depots have set up by CPA to distribute the drug for treatment of civilian patients also. Streptomycin producers have contributed nearly $1,000,000 to finance a program of clinical research under the direction of the National Research Council.

CONSTRUCTION MATERIALS

Proper selection of construction materials was one of the most important phases of design. This was necessary not only from the standpoint of equipment corrosion, but perhaps more important, to prevent contamination of the product. While plain carbon steel is satisfactory for many processing operations, stainless steel is generally used. Stainless steel is used for pipes, fittings, valves, pumps, tanks, filters, evaporators and other process equipment. Much of the equipment at the finishing plant is made from stainless steel. Rubber lined tanks, porcelain piping, valves and fittings, Hastelloy filters and Durichlor pumps used in the elution process. Rubber covered pump impellers are used to combat erosion from carbon slurries.

PROCESS CONTROL

Throughout the whole process, measurement and control of variables is vital to efficient operation. Over $200,000 worth of instruments, including many types and makes, form an integral part of the process equipment. From incubation of test tube cultures to final packaging, all operations are under the constant surveillance of automatic control instruments.

Temperature recorders and controllers are probably most widely used. Rotameters are employed extensively to measure flow of fluids throughout the process. In many instances, and especially with pH, each instrument installation has a complete auxiliary so that at no time will the process be uncontrolled.

All liquid storage and surge tanks are equipped with level gages or controllers. Automatic feeders are tied in with flow controllers to proportion filter aid and activated carbon to the flow of process liquor. McLeod gages are installed on the high vacuum dryer units.

Close laboratory control is not only essential as a check on operations but is necessary to maintain product quality. Throughout the whole process, wherever a unit operation is performed, samples of materials in process are taken regularly for both chemical tests and micro biological assays. In this way faulty operation is quickly detected and quality of product determined.

PRODUCT QUALITY

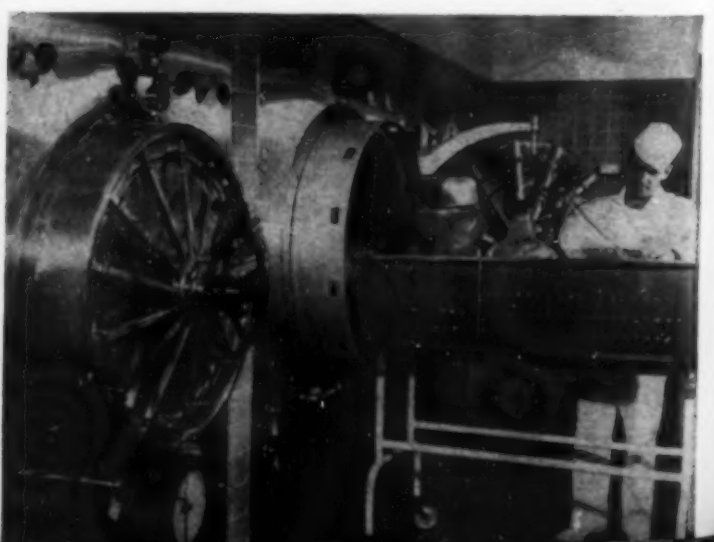
At Elkton alone, some 50 to 60 trained persons are employed in the control laboratory on a-round the clock basis. Here, many hundreds of samples daily are assayed for streptomycin activity and are analysed for process information. Results from assays and chemical tests, as well as chart records from all instruments are channeled to a single individual who evaluates all data. He, then, has the whole picture of daily plant operation and is thus able immediately to put his finger on any possible irregularities and can instigate corrective steps.

While each manufacturing department assays its own particular product for purpose of production control—before the name Merck is affixed to any product—it must be passed by the home control laboratory at Rahway. Responsible only to top management, this department takes its own samples and analyses then independently. Where human lives are at stake there can be no compromise with quality.

Acknowledgment for cooperation and assistance in the preparation of this article is made to Mr. Blythe Reynolds, Dr. William H. Engels, and Dr. Herbert Silcox of Merck & Co., Rahway, N. J.

Left—Complex purification reactions occur in these tanks

Below—Autoclaves sterilize containers and other equipment



JOHN HAPPEL, ROBERT S. ARIES and WILLIAM J. BORNS
Socony Vacuum Oil Co., Polytechnic Institute of Brooklyn and Socony Vacuum Oil Co., respectively

Estimating Chemical Engineering EQUIPMENT COSTS

Chief items upon which chemical engineering economics studies are based are: investment, operating costs and expenses, and income tax and profit. The authors of this article start here a discussion of these items and present systematic procedures for their calculation. The article will be continued in a subsequent issue.—*Editors*

CHEMICAL engineers making economic studies are often called upon for preliminary cost estimates for equipment. Such studies usually involve new installations of equipment for processes resulting from research and development work. Estimates of this type may have to be made for many projects which are not carried out and there is a practical limit to the time which may be spent on them. However, since important decisions are frequently based on such estimates, it is essential that they be made in such a manner as to secure the greatest accuracy consistent with the effort expended. For this purpose, some systematic approach is preferable to the "guesstimate" method.

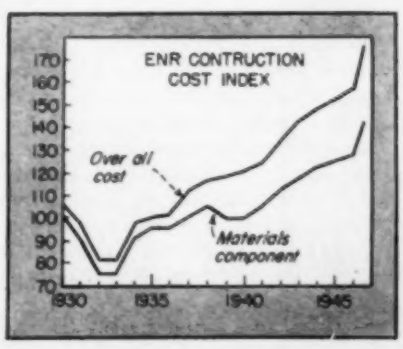
INVESTMENT

Articles have been published* presenting data on the costs of process equipment and accessories. The data in these papers are based on the prewar period; since that time costs have increased considerably and it appears that high prices will prevail for some time to come. Information of this type is brought up to the level of September 1946 in this article. The scope of the cost data is extended so as to include erection and installation labor costs, indirect construction expenses, general overheads, contractors' fees, and other items necessary for the preparation of a valid cost estimate. These last mentioned factors are of great importance for summaries of recent construction costs indicate that the so-called basic items (vessels, towers, furnaces, steam generators, heat exchangers, pumps and compressors) constitute only 15 to 30 percent of the total investment.

The methods presented are particularly adapted to the petroleum industry and the manufacture of allied chemical products. It will be noted, for example, that little consideration has been given to nonmetallic equipment. The method of developing an economic study as summarized here is nevertheless applicable to almost all types of chemical process industries.

One of the precautions which must be taken in cost estimating is to allow for the fact that information, once compiled, soon becomes obsolete and useless. In order to keep abreast of the times, the use of a construction cost index, such as the one compiled by *Engineering News-Record* has proved very useful. The ENR index is corrected monthly.

Another troublesome consideration in cost estimating is the difference in prices at different localities. *Engineering News-Record* periodically summarizes certain key construction costs in several cities scattered about the country, from which it is possible to compute a location cost factor by weighing the relative costs according to their distribution in the particular estimate. Location factors have been calculated for typical petroleum processing plants based on weighted relative costs of steel structural shapes and plates, pipe, cement, lumber, skilled and unskilled labor. It will be noted that in many cases, high material costs are offset by low labor costs.



Location Factors, Summer 1946

(Chicago = 1.00)

Boston	1.015
New York	1.055
Philadelphia	0.992
Detroit	0.984
Chicago	1.000
St. Louis	1.020
Kansas City	1.007
Dallas	0.971
Los Angeles	1.109

Calculated from *Engineering News-Record* data.

A chemical plant estimator must be aware of material base points and equipment fabrication centers in order to make proper freight allowances. If the plant is to be located in any of the several important industrial areas, freight on equipment and material is not a large item. In any of these areas fabricators are equipped to supply almost a complete line of the ordinary processing equipment. Examples of price base points on semi-finished materials are the following:

1. Structural Steel—Pittsburgh, Chicago, Gary, Birmingham, Buffalo and Bethlehem.

ENR Construction Cost Index

(1926 = 100)

Year	Materials Component	Over-all Construction Cost
1930 Jan. 1	100	105
1931	90	98
1932	75	81
1933	75	81
1934	90	97
1935	95	100
1936	95	101
1937	100	112
1938	103	116
1939	100	118
1940	100	120
1941	105	124
1942	112	133
1943	117	143
1944	122	148
1945	125	152
1946	128	157
1946 July 1	142	176

Engineering News-Record, vol. 137, p. 67 (1946).

* Bliss, H. H., *Chem. & Met.*, pp. 87-98, Dec. 1941.
Fowler, F. C., and Brown, G. G., *Trans.* AIChE, vol. 39, p. 241, (1943).

2. Steel Plates—Pittsburgh, Chicago, Gary, Cleveland, Birmingham, Youngstown, Sparrows Point (Md.), Coatesville (Pa.), and Claymont (Del.).

3. Steel Tubulars—Pittsburgh, Lorain, Gary.

4. Copper and Brass—Bridgeport.

Proposed chemical and petroleum plants are often submitted to construction firms for preliminary estimates. However, data of this kind should be used, only with a full understanding of the point of view of the construction company as a vendor of equipment. Such estimates will reflect the interest of the construction firm in the particular project and the current trends in volume and competition in the construction business. Furthermore, a complete understanding must be had as to what the estimate does and does not include in spare equipment, quality of equipment, overcapacity, factors of safety, and off-battery-limits construction. The design of the proposed plant cannot be developed satisfactorily unless the equipment is selected and sized for one's own economic interests.

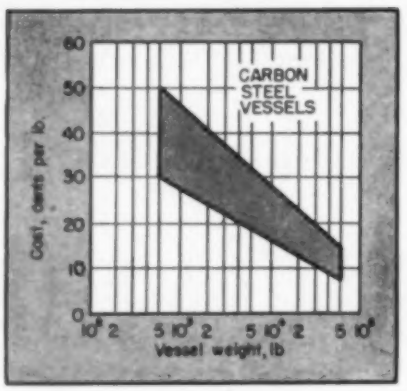
Data from detailed break-downs of construction costs for similar plants are often used to estimate the investment required for a new process. Information from these sources must be used with caution because it is no more reliable than the purchasing and accounting records. Construction firms quite often "unbalance" their cost summaries in order to cover up overly expensive items or to make attractive certain other items.*

Price trends can be followed in the various trade magazines. For example the base price of steel in various semi-finished forms (structural shapes, plates, etc.) is reported periodically in several steel trade magazines. Application of the standard extras (which do not change often) will give the delivered price of a steel product within warehouse delivery limits. The same method applies to non-ferrous metal products.

Equipment data presented here as a basis for cost estimating have been corrected to Sept. 1, 1946, prices as nearly as available information permits. The arrangement of the material follows, in general, the system of accounts used in chemical and petroleum plant construction.† The various items are classified in this way because of the many details which make up the total cost, particularly the cost of erection and installation. It is important to consider the necessity to design equipment for traffic based on operating time. The operating time duty of a unit is greater than the calendar time duty by the amount necessary to make up for lost time due to maintenance and inspection shut downs.

*Grant, "Principles of Engineering Economy," Ronald Press Co., New York.

†Lewis, R. C., *Petroleum Refinery*, vol. 35, p. 118 (1946).



VESSELS

Vessels are the most common pieces of equipment found in chemical plants. They are used for storage tanks, evaporators, reactors, stillpots, autoclaves, separators, etc. Vessels may be installed with the cylindrical axis horizontal or vertical; unless some unusual condition requires otherwise, the length to diameter ratio of most vessels lies between 3:1 and 6:1.*

Service conditions such as pressure, temperature and corrosion must be considered in choosing the material for a vessel. For example, of the ferrous materials, good corrosion resistance but lower strength at given weight are obtained from the use of cast iron. Of the steels, ASTM-A-10 and A-30 may be suitable for riveted tank construction; A-70 is the most commonly used carbon steel for fusion-welded pressure vessels; and A-312 is used for high tensile strength in vessels which would require 2-in. wall thickness if A-70 were to be used. For high temperature service (over 750 deg. F.) a molybdenum steel like A-204 is used. For low temperature, a nickel steel like A-203 is used. The recommendations of the ASTM should be consulted. The economical use of the various grades of the above and other specification steels has been discussed* and for ordinary vessels, ellipsoidal heads are most economical for working pressures above 200 psi.; API code dished heads are best confined to code vessels under 200 psi. and standard dished heads are suitable for non-code vessels under 30 psi.*

Vessels should be designed according to the "ASME Rules for Construction of Unified Pressure Vessels" or the API-ASME "Code for the Design, Construction, Inspection and Repair of Unfired Pressure Vessels for Petroleum Liquids and Gases" when either one applies. Complete details need not be worked out for preliminary estimating but sufficient information should be developed so that the weight of the shell, heads, nozzles, manholes and supports can be calculated.

Most new vessels are fabricated by welding. Welding shops often estimate the cost of a vessel from the cost of the material and the cost of forming and welding the components. This method is the most accurate but it requires knowledge of the vessel details and information on welding shop labor costs and overheads. Since these data are not usually available, a simpler method can be resorted to, which consists of estimating the cost of the vessel by applying a price per pound to the total weight. The following table lists unit prices prevailing during the middle of 1946 for carbon steel (ASTM-A-70) vessels.

Vessel Weight	Cents per Lb.
500	30–50
1,000	25–40
5,000	20–35
10,000	15–25
20,000	10–20
50,000	08–15

Alloy clad vessels cost about 40-50c. per lb. Experienced estimators usually price the forged components such as nozzles, flanges and manholes separately, usually at 60c. to $1 per lb. The weight of these items can be obtained from catalogs.

The direct labor required to install a simple carbon steel vessel upon its foundation costs from 5 to 10 percent of the total estimated price of the vessel.

TOWERS

The length to diameter ratio of a tower is considerably over 6:1 and the installation is vertical. Towers are used for phase contacting and include stills, absorbers, some catalytic reactors, extractors, dryers, and many other items. Whereas the shell of a tower is usually nothing more than a long vessel, the other elements of a tower often become quite complex. In addition to the components of the shell, which may be estimated as indicated above for vessels, a tower may contain packing, catalyst, tubes, baffles, bubble trays, internal piping, etc. Tower packing, depending on the type and size, will cost from $5 to $25 per cu. ft. for common shapes. Complete bubble trays in cast iron or steel may be estimated at $10-$15 per sq. ft. of area.

The erection of a tower on its foundation, and the special care which must be taken in levelling and orienting it, result in a considerably greater contractors' labor cost, than for a vessel. While a simple, small-size fractionating tower may cost only an additional 10 percent to erect, a large, complicated bubble tower, in which the tray parts are installed after erection, may require 30 percent for erection.

HEAT EXCHANGERS

Recommendations covering the design of tubular heat exchangers (including condensers, vaporizers, reboilers, and coolers) have been agreed upon by most of the large fabricators and have been published in "Standards of Tubular Exchanger Man-

*Brummerstedt, E. F., *Nat. Pet. News*, vol. 36, pp. R282, R362 & R497 (1944).

Cost of Heat Exchangers

Outside Heat Transfer Area, Sq. Ft.	Dollars per Sq. Ft.
200	6-8
300	5-6
500	4-4.50
1000	3-3.50
3000	2-2.50

Factors:

Pressure, psig.	Multiplier
75	1.00
150	1.02-1.1
300	1.1-1.2
400	1.2-1.3
600	1.5-1.6
Temperatures 650-900 F	1.1-2.0

Construction:

Type	Multiplier
Bundle only	0.3-0.6
Non-removable bundle	0.5-0.7
Clamp-ring construction	0.9-1.0
Internal floating head	1.0
Expansion ring in shell	1.0-1.1
External floating head	1.1-1.2
Reboilers	1.1-1.2

Material:

Type	Multiplier
All carbon steel	1.00
Admiralty tubes, naval brass tube sheets	1.15-1.35
Stainless tubes, lined channel	2-3
Stainless tubes, clad shell and channel	4-6

ufacturers' Association." In addition to these requirements, it is necessary to consider certain other practical limitations when a heat exchanger is to be designed.

1. Selections should be made from fabricator's standard items which will prove to be less expensive than "tailor made."

2. The maximum allowable difference in temperature from inlet to outlet for any one fluid in a given shell should not be exceeded.

3. Exchanger surface should be divided up into enough separate bundles so that no single bundle is too heavy for the maintenance crew to handle.

4. It is often desirable to standardize on certain tube lengths so that bundle maintenance can be simplified.

In the accompanying table is shown the unit cost in dollars per square foot of outside heat transfer area for TEMA, 75 psi., heat exchangers, including nozzles, shell, shell cover, channel, channel cover, tube sheets, floating heat cover, clamp ring, baffles, tube supports, spacers, tubes and bolts all in carbon steel.

The multiplying factors to be used for estimating the costs of exchangers of different construction and materials are included. Installation cost for tubular heat exchangers of carbon steel is approximately 5 to 10 percent of the cost of the units.

Coil and water-box types of coolers and condensers should be estimated as pipe, fittings, and vessels. Double-pipe exchangers can be priced as pipe and fittings. Finned tubes which are usually less expensive than the conventional tube-and-shell equipment under 300 sq. ft., cost about $4 to $5 per equivalent square foot of heat transfer area. The outer shells should be priced as piping.

It should be noted that for plants scheduled for a high time efficiency, spare tube bundles must be provided.

PUMPS AND COMPRESSORS

Various types of pumps which are used in the process industries may be grouped into four classes: reciprocating, rotary (positive displacement), centrifugal, and turbine types. Established standards for these types of pumps appear in the "Standards of Hydraulic Institute."

The type of pump chosen for a particular set of conditions will depend on the kind of fluid, the rate, the head, viscosity, temperature, and suction conditions. Because of the complexity and varied nature of pump designs, it is difficult to estimate pump costs with precision. However, precision is not required because pumps do not often constitute a very large portion of the total plant cost. Quotations from pump manufacturers are advisable if they can be obtained.

Pump duty may be calculated as the hydraulic horsepower required to deliver the fluid at the design rate against the required head. The actual size of pump installed depends upon the hydraulic horsepower, the rate, and the over-all efficiency of the unit. Efficiencies for different types and sizes of pumps vary considerably and familiarity with pumping conditions is necessary to estimate this factor accurately. Some typical values are indicated in the accompanying table (p. 102). Unless otherwise indicated, the costs shown include pump and driver.

The heavy centrifugal pump units listed include single suction, horizontally split, cast-iron and steel pumps and direct-coupled, splash-proof motors. Another table lists extras.

Careful consideration must be given to providing spare pumps, particularly where high time efficiency is to be maintained under severe service conditions. Maintenance simplification requires that, insofar as practicable, the number of types and sizes must be kept to a reasonable minimum. This often involves use of identical pumps for similar duties even though more expensive pumps and less efficient operation is necessitated for some units.

Labor cost for installation of a pump averages about 3-5 percent of the pump cost.

Complete reciprocating gas compressors in the range of 100 to 300 brake horsepower may be estimated according to the unit prices listed below.

Large, electric, motor-driven, centrifugal compressors cost about $40-50 per brake horsepower. The installation of a compressor alone usually requires a labor cost of 10-20 percent of the original price of the machine. However, the auxiliaries to a compressor installation require an additional 20 to 40 percent for steam and electric and 50 to 80 percent for diesel and gas. The availability of large capacity electrical utilities should always be investigated when electrically driven pumps and compressors over 100 hp. are considered, since considerable expenditure may be encountered here.

Compressor Costs

Drive	Dollars per B.h.p
Gas engine	65-80
Diesel engine	80-100
Steam engine	50-70
Electric motor	55-70

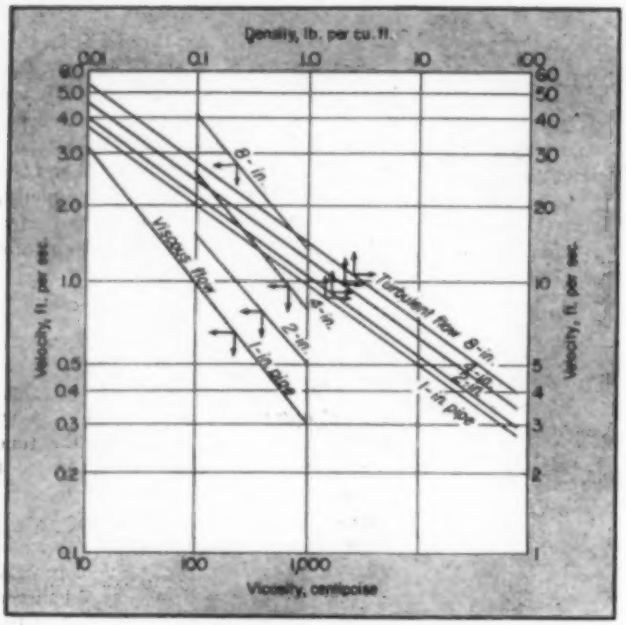
PIPING

Detailed estimation of piping costs is very tedious and time-consuming and much of the information pertinent to piping, drains, etc., is not available at the time when preliminary estimates are made. It is necessary, therefore, to resort to some more convenient correlation of piping costs. Summaries of piping materials expenditures for several different types of processing plants appear to lie as a rule, between 20 and 50 percent of the total cost of the major process equipment. Included in major process equipment are the following: vessels, towers, furnaces and steam generators, heat exchangers, pumps and compressors, and rundown or process tanks. Piping for a tank farm or a gas holder should be estimated separately. The percent piping materials cost based on major equipment is low, say 20-30 percent, for units in which either the major items are complex and expensive or the piping system is unusually simple. For some types of chemical plants, the piping material cost amounts to only 10 percent of the cost of the major items. Severe process conditions requiring expensive valves, and auxiliary start-up, safety, shut-down, and clean-out lines may result in a piping materials cost greater than 50 percent of the major equipment cost. The field labor for piping a process unit costs from 70 to 100 percent of the piping materials price.

In cases where it is necessary to make a detailed piping cost estimate and when the rules outlined above do not apply, a procedure must be followed whereby the individual lines will be sized and priced.

In estimating the size and weight of pipe, in addition to the economics of fluid flow, there are some more or less irreducible factors which must be considered and which usually result in pipe sizes and weights somewhat greater than the economic optimum. The economic pipe size indicated below can be used as a basis for line sizing in the cost estimate.

Among the factors other than pure economics are severity of service, maximum traffic, and requirements peculiar to processes. In general, liberal safety factors are allowed so that the piping system of a unit will not become a bottleneck. Some practical limitations in the design of piping based upon operating experience are given on the following table (p. 102).



Economic Fluid Velocity, Ft. per Sec.

Diameter, In. (Nom.)	Viscous Flow — Viscosity, Centipoise			Turbulent Flow — Density, Lb. per Cu. Ft.							
	10	100	1,000	0.01	0.1	1	10	40	50	60	70
1	3.1	1.0	0.3	38	19	10	4.8	3.3	3.1	2.9	2.7
2		1.5	0.5	40	21	11	5	3.4	3.2	3.0	2.9
4		2.5	0.8	45	24	13	6	4.1	3.8	3.6	3.4
8		4.1	1.3	54	28	15	7	4.5	4.3	4.1	3.9

Sarchet, B. R., and Colburn, A. P., *Ind. Eng. Chem.*, vol. 32, p. 1, 249 (1940).

Maximum Allowable Velocity in Pipe

Service	Ft. per Sec
Simplex reciprocating pump discharge	4–6
Duplex reciprocating pump discharge	5–10
Centrifugal reciprocating pump discharge	6–12
Pump suction	1–3
Gravity flow	0.5–1
Side draws	1–2

Centrifugal Pump Extras

(For pumps up to 30 h.p.)

Fittings and trim	
11.5–13% Chrome	5–10%
11.5–13% Chrome fittings, Stellite trim	30–30%
Impeller	
11.5–13% Chrome	5–10%
18–8 Stainless	8–15%
Monel	10–20%
Case	
Bronze	10–25%
Cast steel	30–60%
11.5–13% Chrome	60–100%
18–8 Stainless	90–130%
Monel	120–170%
Lead lined	90–130%
All stoneware	150–200%
All Hastelloy	500–800%
Driver	
Explosion-proof motor, 1–5 h.p.	$40 flat
5–10 h.p.	$50 flat
10–100 h.p.	$5–$7/motor h.p.
Turbine (non-condensing)† 10–30 h.p.	$35–$0/h.p.
30–100 h.p.	$15–35/h.p.
100–300 h.p.	$ 8–15/h.p.

Note: Large pumps in alloy are usually specially fabricated and costs must be obtained from manufacturers. † Extra over electric motor.

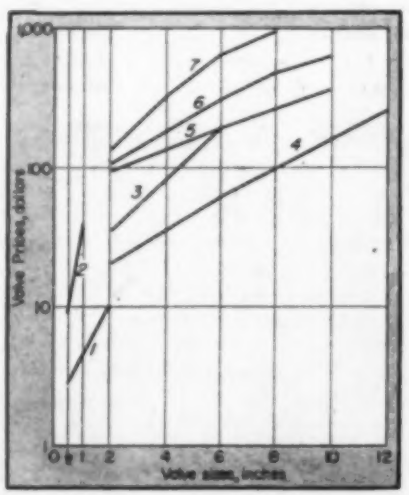
Pump Costs

Type	Driver Horsepower	Efficiency, Percent	Cost, Dollars per H.P.
Small centrifugals, rotaries, light duty	to 1	1–10	$100–200 flat
Small centrifugals, heavy continuous duty	to 1	1–10	200–400 flat
Small plunger pumps	to 1	0.5–3	$200–400 flat
Small plunger pumps	1–5	1–5	400–600 flat
Centrifugal water pumps	1–5	10–20	$20–50
Centrifugals, heavy duty, under 250 deg. F.	1–5	10–60	$100–200
	5–10	20–80	60–100
	10–30	30–80	25–60
	30–100	40–85	12–25
Centrifugals, heavy duty, over 250 deg. F.	1–5	10–20	$150–400
	5–10	20–80	90–150
	10–30	30–80	50–90
	30–100	40–85	18–50
Centrifugals, heavy duty, high clearance	10–30	20–27	60–150
	30–100	30–75	20–60
Piston, direct acting steam†	1–5		$100–200
	5–10		80–100
	Over 10		50–80
Plunger, direct acting steam†	1–5		300–500
	5–10		200–300
	Over 10		150–200
Plunger, power driven (with driver)†	10–50		250–400

The lower range of the quoted prices and the higher range of efficiency values should be used with the higher-capacity lower-head pumps. When viscous fluids are pumped, allowance must be made for the effect on efficiency, head and capacity. † Max. hydraulic horsepower and dollars per h.h.p.

Materials and fabrication rules for piping are contained in the ASME "Code for Pressure Piping." The weights per foot of length for various kinds of pipe are tabulated in engineering handbooks.

The list price for most steel (so-called iron) pipe is $200 per ton, on which various discounts are applied for different sizes and specifications at different locations. The mill price for ordinary lap- or butt-welded pipe is 5 to 7c. per lb. to which must be added freight, warehouse, jobber and quantity charges. Seamless pipe is recommended for process lines and costs 6 to 10c. per lb. for the sizes commonly used. Forged steel fittings and flanges may be estimated at 50c. to $1 per lb. The weights of these items may be obtained from manufacturer's catalogs or engineering handbooks. Liberal allowances, from 10 to 20 percent, must be made for waste, errors, and other contingencies. Instrument piping must also be included.



Fittings and valves usually constitute 60 to 75 percent of the total piping cost within the battery limits of the unit. Some typical valve costs are listed in the accompanying table. Additional costs are involved when alloy trims or linings are specified.

Valve Prices

Curve No.	Type	Size	Cost Dollars
1	Bronze gate	½	3
	(125–150 psi.)	1	4
		2	10
2	Stainless bar-stock	½	9
		1	40
3	Steel Plug	2	35
	(125–150)	4	80
		6	190
4	Cast iron gate	2	20
	(125–150)	4	35
		6	60
		12	250
		24	1,050
5	Cast steel globe	2	95
	(150 psi.)	4	120
		6	190
		8	260
		10	360
6	(300 psi.)	2	105
		4	180
		6	310
		8	480
		10	620
7	(600 psi.)	2	135
		4	320
		6	640
		8	950
		10	1,450
	Diaphragm control	½	60–90
		1	60–120
		2	120–160
		4	150–350
		6	250–500
		8	300–700
	Relief	1	50–80
		2	100–200
		4	250–600
		6	300–900

Safety in Transporting Flammable Chemicals

C. L. JONES
Safety Engineer, Hercules Powder Co., Wilmington, Del.

One of the hazards of the chemical industry is the transportation of flammables over the highway. Here is how the Hercules Powder Co. has met the problem. The protective devices on its nitrocellulose trucks are good medicine for any flammable product.—*Editors*

From its plant in Parlin, N. J., the Hercules Powder Co. sends a variety of more or less flammable products by truck into the neighboring areas of New York, New Jersey and Pennsylvania. Seven trucks have been specially adapted for this service. An average shipment of nitrocellulose, which represents the most hazardous cargo and the one for which protective measures must be geared, will consist of 45 or 50 ICC 6-C containers (galvanized steel drums) with a total weight of about eight tons. The problem of fire prevention under these conditions is approached from three main directions: the driver, mechanical alterations on the truck, and fire extinguishing equipment.

THE DRIVER

As to the drivers, the emphasis is on careful selection. A training program is useful, but the only real answer is to handpick men for the qualities of reliability, courtesy, and a natural inclination to obey traffic rules and play safe on the highway. There is no substitute for experience either; each driver on these special trucks has been with the company about 15 years, driving various types of automotive equipment.

MECHANICAL MEASURES

Mechanical alterations to the truck, except for a 35-m.p.h. governor, are aimed principally at the electrical wiring system, exhaust pipe, carburetor, and gasoline. In a truck, or any gasoline powered unit, these are the "hot spots" as far as fire hazard is concerned.

Safety features include the following: A protectoseal on the gasoline inlet of the fuel tank and another on the air horn of the carburetor; a metal shield over the exhaust pipe from the engine to a point well back of the fuel tank; the installation of the fuel tank in the cab under the seat, where it is less likely to be damaged; a fairly fine mesh screen over the end of the exhaust pipe to break up large particles of glowing carbon; a metal shield with asbestos paper between it and the under side of the truck body deck; a metal sediment trap in the fuel line instead of the usual glass one.

EXTINGUISHERS

The fire extinguishing system is a built-in Kidde carbon dioxide unit that automatically floods the entire engine compartment, the zone around the gas tank, and the ground under the engine. The system is designed to smother a fire on the principle of total flooding, that is, by completely filling the engine compartment with CO_2 in the shortest possible time, usually less than 20 seconds. In addition to smothering the fire, the method has the virtue of "killing" the engine when CO_2 enters the carburetor.

Outside the cab are a 20-lb. cylinder of liquid CO_2 (850 p.s.i.), its discharge valve, and, in case the driver is quicker than the automatic detector, a manual control for the release valve. Two copper tubes lead into the engine compartment, one going to the automatic detector and the other to spray nozzles on both sides of the engine. The 20-lb. of liquid CO_2 will expand to about 160 cu. ft. of gas, which is regarded as enough to smother any incipient fire; the quantity was determined after many tests in which truck engine fires were set and extinguished with considerably less than 20 lb. of CO_2.

Maintenance of the system is simple; it consists mainly of closely checking over the various parts once a week. Ordinary maintenance procedures for carbon dioxide systems require that they be checked annually or semi-annually, but those on the trucks are gone over more frequently because it is felt that the service, with its motion and vibration, is more than ordinarily severe.

(Below) Four of Hercules' seven special trucks for transportation of flammables. Each has, among other protective devices, an automatic CO_2 fire extinguishing system built into engine compartment. At upper rear of engine compartment, where it should catch first flames, is a detector (right); it is filled with powder and connected by small copper tube to release valve on CO_2 cylinder outside cab. Pressure from ignited powder opens valve and CO_2 discharges, via larger tube, from nozzles (not shown) on both sides of engine.

Pharmaceutical Plant Uses Scale Models for Plant and Equipment Layout and Design

The idea of using scale models of rooms and equipment in designing plant layouts is not new but it is doubtful if the scheme has often been used with the care and fidelity to detail found in the models of the Johnson & Johnson "baby products" plant now being completed at Cranford, N. J. Equipment, operators, instruments, storage and handling facilities were all shown in lifelike detail, and all operatiops worked out.—*Editors*

FULLEST possible use of scale models in the planning of both the physical layout of equipment and the actual operations required in automatic production of a line of "baby products" has been made by Johnson & Johnson, New Brunswick, N. J., in the planning of the new one and one-quarter million dollar plant which the company is completing at Cranford, N. J. The plant is of modern design, largely one story, with an over-all size of 250 by 315 ft. and a total floor area of 120,000 sq. ft. About 65 percent of this area is on the ground level, the remainder in a basement. Since the utmost cleanliness is necessary the plant's manufacturing area is completely air conditioned. To reduce the refrigeration and heating loads required while retaining the cheerful effect of a continuous, uninterrupted line of windows along two sides of the manufacturing room, Libbey-Owens-Ford Glass Co.'s Thermopane double-pane glass is being used, the outer pane a heat-absorbing glass, with a dehydrated air space between the two panes.

The manufacturing area comprises a single 50 by 285 ft. room, without columns or posts, having walls of flush construction and a special vinyl plastic flooring. Acoustic ceilings are used, together with fluorescent lighting providing a maximum of 45 ft.—candles of illumination. Functional design is employed throughout, together with colors for floors, walls and equipment designed to minimize fatigue and eye strain. At the center of the manufacturing area is a group of glass inclosed rooms serving as foremen's offices, process control laboratory and first aid room. As shown in Figs. 1 and 2, equipment lines for the six manufacturing processes are laid out in "U" shape, with conveyors feeding in and out, from and to the warehouse section where raw materials are received and stored, and finished products are cased and shipped.

In the seven views of the model equipment shown here Figs. 1 and 2 show respectively the manufacturing and warehouse area, while Fig. 3 has a plate of glass substituted for the floor of Fig. 1 to show also the basement. Figs. 4 to 7 show details of the various manufacturing groups, progressing in that order away from the foreground of Fig. 3.

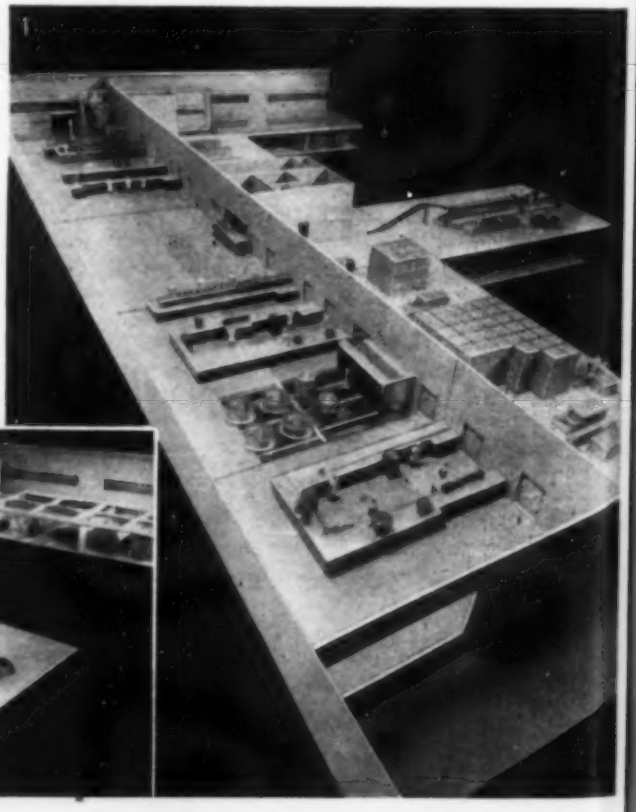


Fig. 1—This view shows the scale models of the six manufacturing lines, together with the warehouse section to the right of the partition wall; note that even the operators and instruments are shown to scale

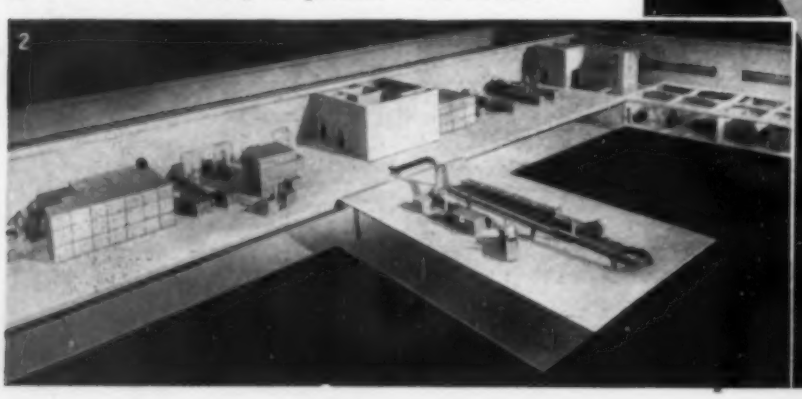


Fig. 2—Here in the scale model of the warehouse section problems concerning receipt and storage of raw materials and handling of products were worked out

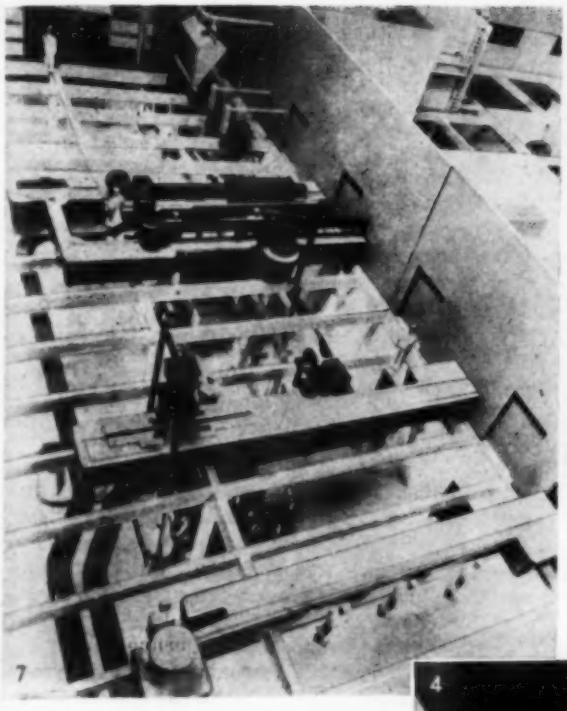


Fig. 7—The far portion of the main floor appears here, together with the blending equipment in the basement shown in Fig. 6 (upper right)

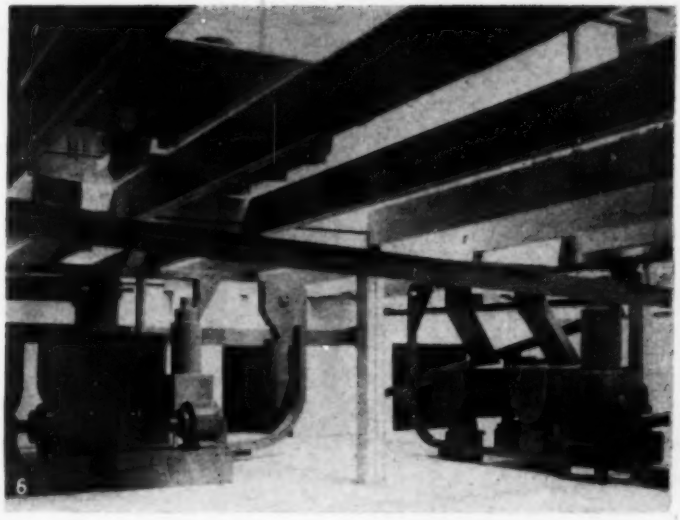


Fig. 6—These blenders and associated handling equipment, exact in scale and location, are situated in the basement under the last two production lines that appear in Fig. 7

Fig. 4—This close-up shows the first manufacturing group and beyond it the kettles detailed in Fig. 5

Fig. 3—This view, similar to Fig 1 except that the basement appears through a sheet of glass, provides the key to the details of manufacturing sections shown in Figs. 4 through 7

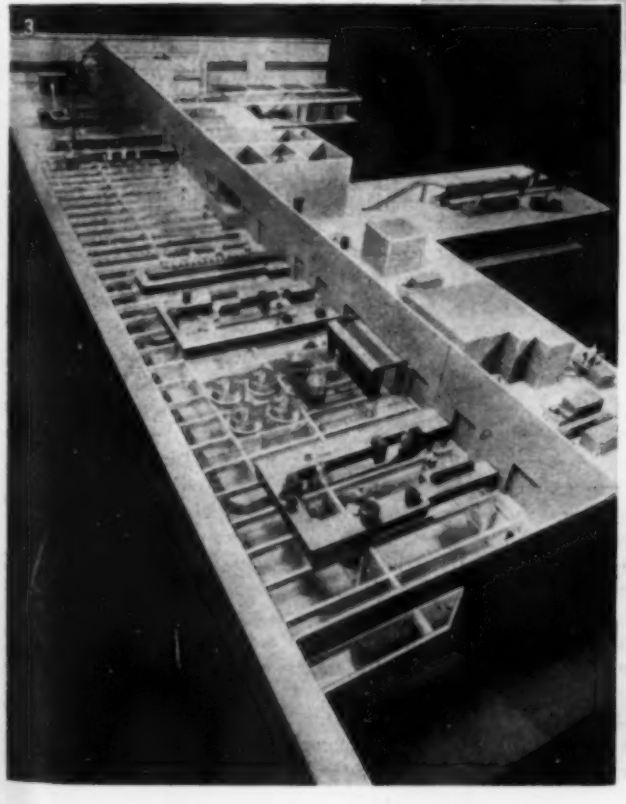
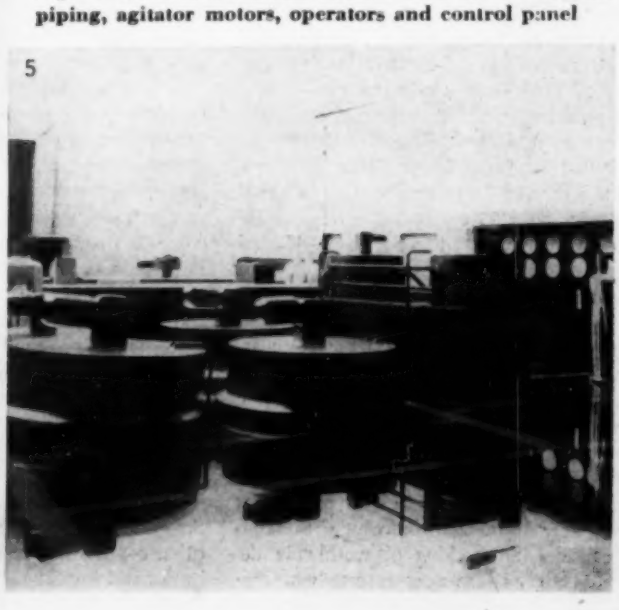


Fig. 5—Note how realism extends even to showing the piping, agitator motors, operators and control panel



KARL FALK *Fresno State College, Fresno, Calif.*

SWITZERLAND

Plans To Increase Exports of Chemicals

For several years, the writer served as special correspondent for *Chemical Engineering* in European countries and gained wide first-hand knowledge about the chemical processing industries of that continent. Since his return to this country, he has kept informed on the status of those industries in the transition from wartime to peacetime conditions.—*Editors*

FACING THE future with cautious optimism, the Swiss chemical industry, which normally exports over 90 percent of its production, is taking steps which any well established business would to retain its position in changing world markets. World War II problems of Switzerland's leading export industry differed considerably from those of World War I, and the same is true of postwar problems. That the changeover from war to peace is being swiftly accomplished is attested by the fact that for the first half of 1946 Switzerland exported chemical products valued at 174.6 million Swiss francs as against 92.3 million francs for the first half of 1945. This compares with a prewar 102.1 million the first half of 1939, and 79.4 for the corresponding period of 1938. Furthermore, United States is figuring increasingly in revived Swiss import and export trade.

In sound financial condition, with good worldwide contacts, over 300 Swiss chemical plants employing around 20,000 highly-trained workers, are concentrating on specialties, chiefly pharmaceuticals, dyestuffs, cosmetics, and electrochemical products. They are aided by the fact that they hold many excellent patents on specialized products for which there is a considerable backlog of worldwide demand. Obsolete processes are being replaced, plants modernized and expanded, and as raw materials are gradually becoming available, the Swiss are energetically pushing into their own former markets as well as into those vacated by the Germans and not filled by larger producing countries preoccupied with supplying their own domestic needs.

Basel, for example, is now the site of the International Fur Fair, held for centuries in Leipzig, Germany. The Fair, held September 2-8, prominently displayed chemicals related to this industry. Similarly, at the 1946 traditional Basel Fair, Swiss exhibitors for the first time showed much larger sized pieces of processing equipment for the chemical and food industries, another spot, which along with laboratory equipment, the Germans are vacating. Until war damages are repaired in liberated and occupied areas, Switzerland is thus enjoying a unique position among continental chemical producing countries because of its ability to utilize existing plants.

WARTIME CHANGES

Optimism is tempered, however, by the realization that great structural changes have taken place during the war when new domestic industries sprang up in countries that were former export markets. The lack of domestic raw materials, especially coal, phosphates and potash, sulphur, ores, essential oils, etc., which prevented Switzerland from taking advantage in export markets of the preoccupation of the warring nations, is being overcome as disrupted continental transportation facilities are gradually restored. However, new sources of supply have to become established since Germany, which before the war supplied over 40 percent of Swiss chemical imports, is currently almost entirely eliminated.

To help achieve a reorientation in the export field, the Swiss already have negotiated trade agreements, in which chemicals figure prominently, with France, the Soviet Union, Czechoslovakia, Spain, and other countries. In the prewar period high duties and import restrictions against their specialty products led the Swiss to establish branch works in France, England, United States, Germany, Italy, and Poland. Branches as in England and the U. S. were allowed considerable independence and helped considerably in carrying the parent firms through the war.

Aside from the difficulties of re-establishing trade with neighboring countries, Germany, Italy, and Austria, formerly also important markets for Swiss chemical exports, the Swiss are handicapped by their subsidiaries in those countries being blocked, and by financial restrictions delaying transfer of funds and earnings from other countries. The rising costs of imported raw materials, higher costs of labor —recent labor disputes being settled in Basel and Geneva—higher costs of production incidental to essentially smaller-scale operations, and the currency disadvantage of the Swiss franc, all are factors putting the Swiss at a competitive disadvantage.

However, these factors have all been discounted by Swiss chemical producers who are confident that their excellent wartime research and planning, long production experience, modernized plants employing many skilled workers, and concentration on specialized products will assure them in the long run a fair share of a growing world chemical market in any kind of reasonably ordered world economy.

Before the war Switzerland ranked eleventh in world chemical production, with Germany, Great Britain, France, Italy, Belgium, and Holland surpassing her on the continent. As a considerable net exporter of important products, however, Switzerland still supplied 4.3 percent of total world chemical exports in 1938. This quantitative figure does not do justice to the importance of this industry to the Swiss economy, for chemicals (including aluminum) often have topped machinery, watches, and textiles as this small country's chief export item, and the chemical industry, along with the machine industry, accounts for the largest amount of capital invested in any Swiss manufacturing branch.

At the time the Allies liberated west-

ern Europe, trade with Switzerland's neighbors had practically come to a standstill, but gained momentum again in the spring of 1945 when domestic controls and foreign trade and raw material restrictions were lifted. The reorientation of markets that has taken place is illustrated by the fact that dyestuff exports for the first eight months of 1945 went principally to India, followed by Spain, Sweden, Argentina, Great Britain, and United States, with our share increasing steadily since that time. Dye exports have also been resumed to Belgium and France and to Portugal, Mexico and several South American countries.

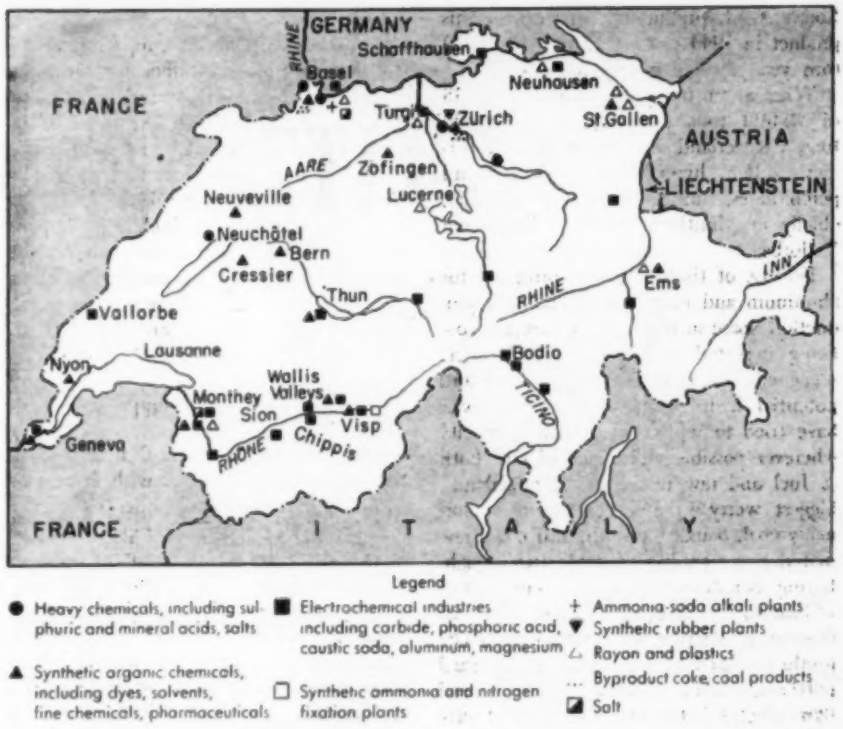
GAIN IN DYE TRADE

Dyes are again approaching the importance they had in prewar trade when they generally represented about half of the total value of Swiss chemical exports. Of the total Swiss chemical exports of 174.6 million francs for the first half of 1946, dyestuffs and indigo were valued at 75.3 million francs (44.8 for the first half of 1945), industrial chemicals 21.5 million francs (5.2), while pharmaceuticals and cosmetic products reached 77.8 million francs (42.3).

Pharmaceutical production has long been closely allied with dye production, many of the same firms making both types of products, and its origin also dates back to the middle of the last century. Its greatest development has been in Basel, with other facilities in Geneva, Berne, Zofingen, Zurich, Nyon, and St. Gallen. The industry has specialized in synthetic drugs, and in processing vegetable and animal organic extracts. Output of vitamins and concentrated food products (especially evaporated milk and chocolate) has been of growing importance.

Recent new products (Ciba) include "Antistin" for allergies which in combination with "Privin" is useful in combating hay fever, and a new synthetic oestrogen "Fenocylin." The future of Swiss exports in this field, however, will be affected somewhat by German developments. As it now stands, the German phamaceutical industry is to be limited to 80 percent of 1936 capacity, and should furnish a considerable share of the 3,000 million RM annual exports (in terms of 1936 values) to be allowed by the Allies.

Swiss perfume and cosmetics production has traditionally been centered around Geneva and Nyon, also in Dubbendorf and Brugg near Zurich, with essential oils and synthetic perfumes being chief products. Considerable amounts of raw materials formerly were imported from East Asia, for instance, menthol from China, agar agar, peppermint oil, beeswax, spermaceti from Japan. During the war the perfume industry was limited to essences from the French perfume district of Grasse, and then mostly to lavender passed up by German forces occupying France. Small amounts of attar of roses came from Bulgaria, but on the whole Balkan products such as petroleum derivatives and wool fat were expensive and of inferior quality.



DDT PRODUCTION

A noteworthy wartime development illustrating the Swiss chemical industry's unique position is in DDT production. Although first described by a Strasbourg student in 1874, its insecticidal properties were not discovered until 1936-7 in the Basel laboratories of the J. R. Geigy A. G. by Paul Muller, a chemist who was studying mothproofing agents. Marketed in Switzerland as "Gesarol," 200 lb. were sent to the Geigy offices in the United States in 1942, and the product was submitted to both American and British governments. It was patented in Britain by the Geigy subsidiary in 1942 and in the United States in 1943, when it was adopted for use by the armed forces. Output of this product has been as spectacular as that of probably any chemical in recent years.

Swiss electrochemical production is based on the excellent hydroelectric sources of power of the Jura and Alpine rivers (Schaffhausen, Wallis valleys, Vallorbe, and Turgi). The Swiss Aluminum Industrie A. G. was founded in 1880 in Neuhausen with branches later in Chippis (Wallis), Lend (Austria), Rheinfelden (Germany). At one time Switzerland led the continent in aluminum production but has since had to give way to larger aluminum producing and consuming countries. However, through cartel arrangements and the Bauxit Trust A. G. of Zurich, it has retained international influence exceeding Swiss production.

Since no bauxite is mined domestically, Switzerland depends on imports. Arrangements were made recently to import 60,000 tons from Swiss-owned Porto Marghera mines in Italy in return for shipments of dyes and pharmaceuticals. Although the Swiss control bauxite deposits in Hungary, Italy, and France, alumina prices are at present too high to permit the Swiss industry to compete with large foreign producers. Aluminum Industrie A. G. also is faced with its German subsidiaries at Rheinfelden in South Baden and Singen am Hohentwiel being shut down under Allied control programs, a situation similar to that of the Lonza firm of Basel with a 16,000 ton nitrogen plant in Waldshut in Baden, and other electrochemical interests in Germany.

Calcium carbide production started last century in Neuhausen and Wallis and was followed by the manufacture of iron alloys and calcium nitrate. Before World War II a member of the international carbide syndicate which included most large producing countries, Switzerland, which even exported some calcium carbide to Germany and made acetic acid and acetone from carbide, is faced with a situation in which former importers like Great Britain are now self-sufficient and will no longer require Swiss carbide. One wartime development with calcium carbide in Switzerland included a synthetic motor fuel, marketed as "Para" with 75 percent paraldehyde and methanol admixtures. The

Lonza A. G. production capacity for this product in 1944 was stated to be 100,000 tons yearly.

With a caustic soda capacity in 1938 of 18,000 tons and output of 13,000 tons, Switzerland also made alkali chlorides, sodium hypochlorite, chlorates and perchlorates, in addition to chlorine, chiefly in Monthey, Chevres, Turgi, and Vallorbe.

Because of the decreasing prospects for aluminum and other electrochemical production, some surplus electric power is now being exported with economic frontiers reopened. In view of ample actual and potential hydroelectric power, the Swiss have tried to replace coal with electricity wherever possible. The lack of coal both as fuel and raw material is Switzerland's biggest worry in emergency times. Normally coal, bauxite, potash, and other raw materials are readily available from neighboring countries. This year commercial utilization of electric furnaces to burn cement is starting in Switzerland. The product is higher in cost than the usual portland cement. During the war several new electrical tar-extraction plants were installed, and it is claimed they are getting increasing quanties of tar residues and less loss of pressure than with conventional type plants.

CHEMICALS FROM WOOD

The chemistry of wood—one of Switzerland's few abundant raw materials—was stimulated in the war, with considerable production of staple fiber, rayon, cellophane, etc. Wood saccharification schemes are admittedly still of doubtful economic value. The Holzverzuckerungs A. G. of Ems in Graubünden was using waste wood to produce only methyl alcohol, about 6 million liters a year, and had planned to make 2,000 tons of yeast a year to add to domestic feed materials. The Lonza works, which formerly obtained intermediates from German plants, were unable to supply sufficient materials for the Swiss varnish and dyestuffs industry, and the small wood distillation plants of Wimmis and Castione could not produce enough methyl acetate and wood-tar for the domestic market. However, solvents and charcoal are now expected again from Slovakia, Yugoslavia, and other Balkan countries.

During the war, although Switzerland exported some nitrogenous fertilizers to countries such as Spain, the shortage of phosphatic and potassic fertilizers was acute. French phosphates from north Africa and basic slag from northern France are easing the shortage. Earlier this year the Swiss Federal Railways detached from service some 50 cars and sent them to France to transport potash from Alsace, whose potash output is now up to prewar levels but cannot be transported. Swiss agriculture was also hard hit by the shortage of copper sulphate.

Other wartime self-sufficiency measures included establishment by two Swiss companies, Cisac S. A., Cressier, and Muhag S. A., Neuveville, of plans to make previously imported potato starch and starch products. Two synthetic rubber plants also were organized, one in Buehler in Appenzell and another in Altstetten near Zürich. A new iron mine was started near Chemin above Martigny (Valais), and a promising new phosphate deposit was discovered in the district of L'Auberson (Neuchatel).

FINANCIAL POSITION

That the Swiss chemical industry's financial structure is sound with respect to earnings and reserves is evidenced by the recently released annual reports of the leading companies. The foremost concern, Ciba, Society for the Chemical Industry, with important plants at Basel and Monthey as well as abroad, making dyes, pharmaceuticals, plastics, resins, glues, etc., showed a net profit in 1945 of 9.2 million francs (8.1 in 1944), and distributed unchanged dividends of 16 percent. The company has been able to replenish its stocks of raw materials and intermediates and has been getting smoother deliveries the past year. Reconversion has been speeded since the Currie agreement of March 1945 and the permission to resume prewar contracts as well as the lifting of embargoes.

Sandoz, A. G., Basel, fabricating dyestuffs in association with Ciba and Greigy, reported a favorable reserve position and improved export prospects for pharmaceuticals and dyes despite raw material difficulties. J. R. Geigy A. G., Basel, which as a family-held company does not have to render a public annual statement, reports favorable developments, and this firm is enjoying considerable advantages from the production of DDT. Geigy, together with Ciba and Sandoz; took over the majority interest of the fourth largest dye manufacturer, Durant & Huguenin A. G., Basel, from the German I. G. Farbenindustrie in 1939. Durand & Huguenin doubled profits from 423,888 francs in 1944 to 858,930 francs in 1945, and declared a 10 percent dividend (5 percent). It is constructing a new plant to achieve greater independence producing some of its own basic materials.

F. Hoffman-La Roche & Co. A. G., Lausanne, leading pharmaceutical manufacturer, reports new expansion projects. It still has some basic material shortages but states that supplies are being received in growing amounts from territories closed to the company in the war. It allowed considerable independence to foreign subsidiaries in operations but encountered difficulty in transferring profits to Switzerland. With net profits for 1945 of 3.41 million francs (3.53), an unchanged dividend of 40.50 francs per share was declared along with a special anniversary distribution of the same amount.

Chemische Fabrik, vormals B. Siegfried, Zofingen, a smaller firm, is less optimistic in its report. It states that although imports from Belgium, Spain, and overseas are helping break the bottleneck of raw materials, the cutting off of German supplies leaves it short of intermediate products. The firm is also experiencing labor troubles and fears competition of low-priced United States products.

A leading factor in electrochemical production, Lonza Elektrizitätswerke & Chemische Fabriken A. G., Basel, reports unchanged gross dividends of 6 percent and a net profit for the year ending March 31 of 4.3 million francs (4.6). This company, which has experienced difficulties with its subsidiary plants in Germany, has been able to supply domestic demands for nitrogenous fertilizers, but is still suffering from coal shortages. Net profits of Aluminum Industrie A. G., Chippis-Neuhausen, fell from 5.8 million francs to 2.2, partly as a result of blocked foreign holdings, high freight charges, raw material supply difficulties, and general inability to meet price competition of foreign producers who recently lowered their prices.

Much of the future development of Swiss chemical exports will depend on the speed of political settlements, currency stabilization, prices, reconversion in other countries, etc. An incidental result of Germany's elimination from the picture is a necessary revision of Swiss patent procedure. In the past, Swiss inventors used to rely on patent application to Germany to find out whether their invention warranted patent protection. Now a Swiss committee of experts is working out a plan for official interim examination of the novelty of inventions submitted for patent protection.

INTEREST IN CARTELS

Revived Swiss interest in prewar cartel arrangements (minus German members) in the carbide and dyestuffs field has been indicated. The leading Swiss firms, long entirely Swiss owned, have also tried to shake off prewar association with I. G. Farbenindustrie of Frankfort through the holding company I. G. Chemie, Basel, Norwegian Norsk Hydro, etc. Considerable confusion arose over similarity of the name I. G. Chemie, Basel, to I. G. Basel, the latter being a purely Swiss community of interest agreement between the three big dye producers Ciba, Giegy, and Sandoz.

On the whole, after weathering six years of war the Swiss chemical industry is still technically, scientifically, and financially strong. With vigorous expansion projects underway, and some already completed, it has prospects of a bright future.

Protecting Personnel in Handling Portable Electrical Equipment

CHESMAN A. LEE
Engineer, Darling & Co.
Chicago, Ill.

A RECENT rather serious accident in connection with 440-volt power aroused the writer's interest in protective measures beyond the several rather good articles previously published. Of these, "Portable Electric Hand Tools," published by the National Safety Council as its "Safe Practices Pamphlet No. 76," is an example.

Portable conveyors and boxcar loaders are used to handle heavy chemicals. Portable motor-driven tools are used throughout the plant by the mechanics. The chemical engineer may be the only technically trained man in the plant and should have some knowledge of the desired safety measures and their limitations.

The motors used on such equipment are ordinarily small but are often 440-volt, three-phase, 60 cycle and even when 110-volt, single-phase, can be hazardous.

Protective grounding is required for safety but is not sufficient in itself and repeated inspection should be given, especially to the extension cord and terminals. The cord should be fastened physically to the frame, in addition to being connected electrically. No strain should come on the terminals, nor on the cord where it enters the box. Grounding can be accomplished by an extra wire with one end connected securely—electrically and physically—to the frame of the machine; and with the other end clamped or otherwise connected to the steel frame of the building, or to a grounded pipe (or equal).

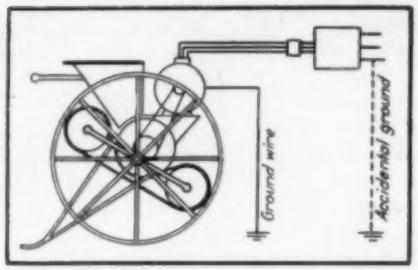
WHAT GROUNDING DOES

So far as the writer knows the following explanation of the value of grounding is novel; certainly it is worth detailed study: "Grounding works for safety in that in most cases a dangerous electrical fault will blow a fuse." The blown fuse gives direct protection and also calls attention to the source of the trouble. Keep in mind that there is nothing about grounding that does not conform strictly with elementary circuit analysis. The 440-volt current does not leak off through the ground wire to become absorbed by the earth as a reservoir. The earth, or building frame, merely provides part of what must be a complete path, closed without any gap. It follows then that for current to flow there must be a second ground, presumably accidental, somewhere on the service side of the transformer. Such grounds often exist; possibly because of careless pulling of wires through conduit boxes, and sometimes in wet weather because of old insulation. In the following discussion it will be assumed that such an accidental ground does exist somewhere in the circuit.

Refer to the accompanying sketch and note the intentional ground from the frame of the loader as shown by the full line. Note the accidental ground shown by the dotted line. A second ground to the frame, in extension of one of the other two wires, will now complete a path for current and the fuse will blow. Note that without a ground wire, the circuit could be completed through the operator's body. Here the ground affords full protection.

There is some chance however for a fault to develop in the insulation so that there is no ground. This leaves a possibility for the operator to get on to a "hot" wire, thus completing a path for current through his body. A scraper or other tool in the operator's hand may cause the accident. In this case the equipment ground is bypassed and offers no safeguard.

In each case there is a complete circuit which can be traced out on paper. In the more usual case complete safety will be afforded. But when one realizes that protective grounding is not in itself sufficient, he will see that proper inspection and maintenance are given.



This "slinger" type boxcar loader illustrates the effect that may come from an accidental ground

Grounding of three-phase equipment can be handled well by using four-wire cord and four-pronged plugs. These plugs are "polarized" and fit only one way. The fourth wire is used for grounding. A fairly good alternative is a fourth wire taped to the cord to avoid snarling, and properly connected to the machine. The loose end can be clamped to some convenient and obviously intended point which in its turn is permanently grounded. In either case there should be a "disconnect" switch and this switch should be open when plugging in. It once happened that a faulty plug was plugged into a "hot" receptacle on a wet day with results that neither the operator nor the writer will ever forget. A ground had been provided but in this case it could not help.

EXTRA SAFETY

An added safeguard can be afforded by using a five-wire cord carrying a relay circuit. A magnetic starter is mounted above the receptacle and a push button on the equipment. Then it is impossible to energize the receptacle until after plugging in.

Some reference should be made to 110-volt, single-phase circuits. In this case one wire is required by the code to be grounded and to be identified throughout the various circuits. Then although there is only one "hot" wire, both wires carry equal current. If polarized plugs are used, the switch can be in the "hot" wire with some increase in safety. Grounding is necessary for safety although still it is not 100 percent sufficient. Here also safety is afforded because the usual electrical fault will blow a fuse. Here again a fault in insulation of the "hot" wire will permit completing the circuit through the operator's body, bypassing the protective ground. The point is that grounding cannot take the place of careful maintenance, although it does afford partial protection which may save a man's life.

Note that single-phase grounding can be done by using three-wire cord and three-pronged plugs. In that case, be sure to see that plugs will not fit any three-phase receptacles in the plant.

Too little attention, the author believes, is commonly given to the proper maintenance and protective grounding of portable electrical equipment, such as conveyors, boxcar loaders and powered tools. Even though the motors used on such equipment are generally small, their power circuits can still be hazardous and have been known to cause serious accidents and even death. Although it might seem that the problem should be left to the electrical engineers, what about the many plants where nobody is electrically trained?—*Editors*

Spectacular Developments Made in INCENDIARIES

RALPH W. HUFFERD
Colonel, Chemical Warfare Service

The story of the development of incendiary bombs used by our forces in Europe and Japan is one achievement after another made outstanding by the difficulties that had to be overcome at every turn. The several types of bombs that were produced added materially to the collapse of Germany and were an important factor in bringing Japan to her knees.—*Editors*

ALL PHASES of Chemical Warfare Service research and development are interesting but to cover them all will require a fairly large volume. Hence, only one of the most effective and spectacular of them, incendiary bombs, will be discussed in some detail here. There has already been much written about our incendiaries, some of which would have been better left unsaid, perhaps.

Although the United States entered the war without any incendiary bombs in production, we were well on the way and were especially blessed by having the very intimate experience of the British at our disposal. Our technical reprcsentatives were shown their techniques, and our tactical missions were acquainted with their doctrines.

The German kilo magnesium bomb had made a great impression on the British. It had proved very effective in London, Coventry and elsewhere. They had developed a 4-lb. bomb which they considered superior to the German bomb. It was a copy of this munition that it was decided to adopt as the standard American small incendiary.

Our plan to manufacture the magnesium bomb had the serious drawback of no magnesium. Nevertheless we went ahead designing and building plants and equipment for filling the prospective bombs, and confidently waited for industry to provide the metal. It must be confessed that there were times when the outlook was none too bright.

But there was no intention of waiting for magnesium to get bombs ready for delivery to enemy targets. A substitute bomb of nearly the same external dimensions as the magnesium bomb was developed and manufactured. It was known as the AN M-54. This bomb consisted of a thin steel case stabilized by means of tubular tail and a heavy nose. It was filled with a thermite type mixture which had been developed for certainty of ignition and carefully controlled burning time. Its dimensions were made the same as those of the 4-lb. magnesium bomb so that the cluster adapters designed for carrying it could be used for the magnesium bomb when it should become available.

On December 10, just three days after Pearl Harbor, a civilian contractor started production on the first lot of M-54 bombs. It was this bomb, a thin steel tube of thermite, that Jimmy Doolittle's fearless group of fliers dumped so effectively and impressively on the Jap cities of Tokyo, Nagoya, Kobe and Yokahoma on April 18, 1942.

We knew the Japs had been impressed by that raid but had further proof of their respect for the M-54 when we received our first sample of their incendiary mixture delivered to our western states by paper balloons. Analysis showed the material to be a very accurate reproduction of the fuel of the M-54.

Magnesium finally became available and several companies started delivery of the cases of the 4-lb. bomb to the loading plants. Lines were quickly put into operation in our arsenals and in the plants of civilian contractors. By this time the bomb had been standardized with the title AN M-50 Al. During 1942 shipments of the M-50 to Britain were well started.

In the beginning we put bombs in 100 lb. clusters and in 500-lb. clusters of the quick-opening type. This type of cluster disintegrates soon after it leaves the bomb bay. Later on, the bombs were clustered in bomb-shaped aimable clusters which can be aimed accurately and caused to open up at any predetermined height above the target. All such clusters carried by American planes were of the so-called 500-lb. size and carried 110 bombs.

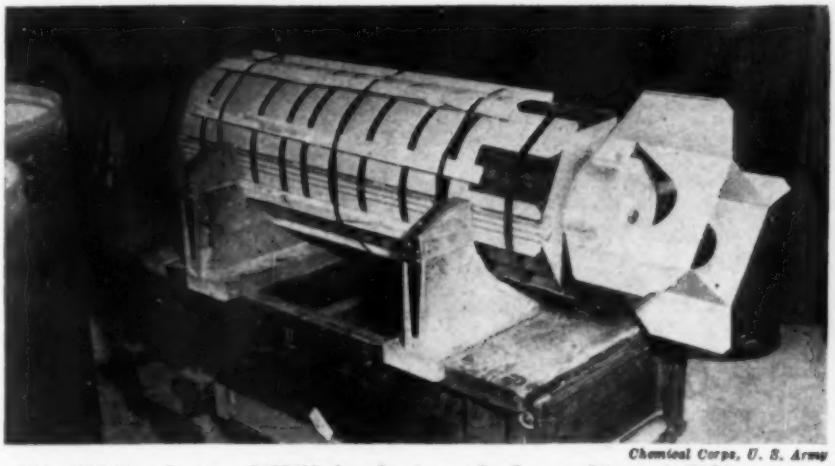
POTENTIAL DESTRUCTIVENESS

Some idea of the production problems and of the potential destructiveness of M-50 raids may be had from the fact that one B-29 carries 40 500-lb. clusters or 4,400 bombs. When that figure is multiplied by 100 or 500 the rain of bombs and calories of a single raid is so great that devastating conflagrations cannot fail to occur.

Although we adopted the 4-lb. magnesium bomb from the British, we found it necessary to expand much research and development effort before it would meet the 95 percent functioning test demanded by our Air Force. An entirely new first-fire mixture, and improved fuel and alterations in design of the fuze were required and accomplished.

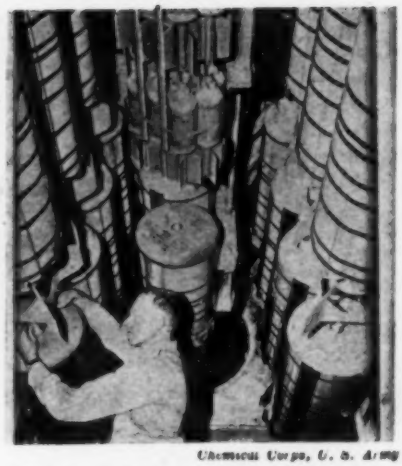
Versatility of attack both as to weapons and tactics is always necessary for maximum effect. Also, there is considerable difference in the ease of starting fires in various types of buildings. Whereas the M-50 bomb could be scattered so as to make a bomber load start many fires in certain types of buildings and building groups, in order to cause damage to other types, accurate bombing of the pin-point type with larger bombs is necessary. When the war started, we were well along in developing a jellied gasoline bomb known as

The author is now associated with the Kendall Refining Co., Bradford, Pa.



Chemical Corps, U. S. Army

This 500-lb. cluster of M-50 bombs is ready for packing. A B-29 superfortress carries 40 500-lb. clusters or 4,400 bombs



Chemical Corps, U. S. Army

Oil incendiary clusters in center flanked by 500-lb. aimable clusters

the AN M-47 100-lb. incendiary bomb. It holds about six gallons of fuel and weighs about 70 lb. when ready to drop.

We had planned to fill the bomb with gasoline thickened with natural rubber. Pearl Harbor changed those plans, and we immediately started to search for another thickening agent. We sought the cooperation of all of the companies manufacturing or doing research on polymers. Some very promising candidates were found, but no sooner was one found than some higher priority need took it from us.

Aid of the NDRC was solicited. They assigned the problem to the group of Dr. Fieser at Harvard.

In answer to urgent request, Drs. Woodhouse and Strain of Du Pont offered some promising materials that were not in demand elsewhere. The Standard Oil Development Co. under the guidance of Messrs. Russell, Myers, and Betts developed a thickened fuel which became known as "applesauce" to all those interested in the project, and which for a while promised to be the best solution to the problem.

SOME PROBLEMS

Before 1942 was four months old, Edgewood chemists had modified one of the Du Pont formulas containing a special methacrylate polymer to produce a thoroughly satisfactory filling which bore the standardization designation, IM-1; and before the year was much more than half gone, a new and satisfactory thickener was presented by the NDRC group under the direction of Dr. Fieser. The Harvard group really had two major problems. They were to find a soap that would meet the needs of the bomb filling, and to use acids for which there was not already a high priority demand. They were also told that it would be highly desirable if the soap would readily disperse in cold gasoline without the use of complicated equipment.

The most promising of the early soaps, a sodium palmitate dispersible in hot kerosene, had been dubbed "napalm" by Dr. Fieser. Since it did not meet the requirements, work was continued. Very close liaison was maintained with Minnich of the Nuodex Co., thus taking advantage of the skills in the art of soap-making of a manufacturing organization. The result of all this research is a peculiar aluminum soap which was standardized under the original name, napalm.

In order to get the soap to disperse in gasoline at a rate that would not be so rapid as to cause the material to setup before it could be loaded into bombs or so slow that long stirring would be required to obtain uniformity, it was screened to a definite grain size distribution. The granular appearing material made an impression on someone with a rather strong imagination, and possibly a not too good biological memory, who gave it the name Fire-foe. This fanciful designation rang true to the journalistic ear, and has appeared again and again in the public print.

Napalm was undoubtedly one of the finds of the war. Unlike the other thickening agent, IM, it is readily dispersed in gasoline in the field, and became the standard thickening agent for fillings of the flame-throwers and the jettisonable gasoline tank. When other munitions took the whole supply of methacrylate polymer, napalm replaced it in the M-47 bomb.

It was early thought that there should be a small bomb of the gasoline type to supplement the 4-lb. magnesium bomb. The problem of developing such a munition was given to the Standard Oil Development Co. under a contract with NDRC-OSRD.

Since a careful study of German domestic construction indicated that the most vulnerable point of attack with fire was in the attics, one of the characteristics of the new bomb was to be that it would penetrate the roof but not the attic floor of German houses. Experiments showed that about the only place a fire could get a start in a clean attic was near the eaves, and that the best way to get the burning fuel into that position was by having it ejected in a single blob. Accordingly, the bomb was designed to function by tail ejection and with a delay in its fuze. It is a small air-borne mortar that penetrates the roof of a house, comes to rest on the attic or upper floor, and then ejects its burning charge toward the eaves or walls of the room.

6-LB. INCENDIARY BOMB

Many months of intensive work at Bayway and at Edgewood Arsenal, and extensive plane drops at Huntsville Arsenal, Edgewood Arsenal and Jeffersonville Proving Ground ultimately led to the standardization of the bomb as the M-69 6-lb. incendiary bomb. Its hexagonal tube body carries a payload of about 2¼ lb. of napalm or IM thickened gasoline gel. Its velocity and stability are controlled by means of cloth streamers which are folded into its recessed tail while in the cluster.

As in the case of the magnesium bomb, the M-69 is clustered in 500-lb. aimable clusters which can be accurately aimed and set to open at any desired height above the ground. Only 38 bombs are carried in a cluster, but at that, one B-29 carries 40 clusters or 1,520 bombs per trip. Some of the great conflagrations in Jap cities bear witness to the destructive power of the M-69 bomb.

Our Air Force found need for a large incendiary to use against highly resistant targets. It was demanded that the bomb have the same high aimability of the 500-lb. general purpose bomb, and that it have the same ability to penetrate strong industrial roofs and walls. It was decided by the Edgewood Arsenal development officers to start with the case of the G.P. bomb itself, and by making a minimum of changes, convert it into an incendiary bomb. Since this case is the heavy wall type, a very powerful burster is required

to open it up, and as a result of the strong burster, a very tough gel is required to prevent excessive scatter and flash burning. The Air Force had introduced another requirement, demanding that the fuel of the new bomb should be more destructive to light machinery and tools than was the case with the fillings of the M-47 and M-69 bombs.

Previous to receipt of this demand, work had been done along the lines of introducing coarse magnesium grains into IM and napalm gels. Success had been attained with the methacrylate gel. However, it had been found necessary to add fine magnesium powder and an oxidizing agent to get the mixture to burn smoothly. It had been observed that the fine powder gave a doughlike consistency to the gel and made it quite elastic.

GOOP

This mixture, known as pyrotechnic gel, showed great promise in the new bomb but a survey showed that all available grinding equipment for magnesium powder was employed in grinding for the Navy and Signal Corps. At this point we had a real break. The engineers of Henry Kaiser's Permanente magnesium plant had gotten the idea that the crude intermediate in their process for manufacturing magnesium would in itself serve as a bomb filling. This intermediate, which they called "goop," is a thick paste of ultrafine magnesium particles, magnesia, magnesium carbide and carbon mixed with naphtha and asphalt.

Extensive tests with goop in the new 500-lb bomb proved that it would not serve as a filling, but by the time these tests were completed, it had been found that the material would serve as a satisfactory source of fine magnesium for pyrotechnic gel. Preliminary tests with various formulations containing goop were tried out at Edgewood Arsenal, and a mixture chosen as the one for final testing. One of the Technical Command Officers flew to California, taking with him the formula and the necessary ingredients for making sufficient mix to fill several bombs. The bomb cases and burster assemblies had previously been shipped to the Permanente plant. The first batch made up behaved so well in the large bombs that it was decided on the spot to finalize the formula and recommend its manufacture and loading into bombs. Of course, as with all materials, there were changes made from time to time in order to gain slight improvements and to speed up loading operations.

This mixture was standardized with the designation, PT-1, and is known officially as pyrogel. Someone with a flare for the spectacular dubbed the fuel artificial lava and the large bomb filled with it, the Goop and the Block Burner.

Hundreds of thousands of the large bombs were filled with pyrogel. Each of them carries about 18 gal. or 175 lb. of the mixture along with about 9 lb. of white phosphorus to make fire fighting less attractive and effective.

Pyrogel is the most difficult of the gels to extinguish. The white phosphorus, which is spread through it by the explosion, causes it to reignite when it dries out after having been extinguished by drowning with water. CWS lost one of its test buildings due to this nasty characteristic of the mixture.

The development of all of the incendiary fuels followed the careful stepwise course of all successful developments. The officers and civilian research directors responsible for their development always took advantage of any breaks coming their way just as would any other experienced professional chemists and chemical engineers.

Certain difficulties with the first small oil bomb, the M-69, arising from its having a one-way fuze and a cloth-streamer tail, led the Edgewood munitions development division to attempt improvements. A revised bomb, the M-74 10-lb. incendiary bomb, has much the same external appearance as the M-69. It clusters the same number, 38, to a 500-lb. cluster; and functions by tail ejection. It differs from the M-69 chiefly in that it is armed with an all-ways fuze which permits it to function when striking at any angle; and has a spring actuate jump out tail which telescopes into the case while in the cluster.

The M-74, like the M-69, was originally designed for use against German attics, hence it was armed with a delay fuze which would permit it to come to rest on the attic floor and eject its charge mortarwise into the eaves. When our efforts turned specifically toward Japanese targets,

Clusters of M-69 fire bombs are packed into waterproof containers
Chemical Corps, U. S. Army

Goop is source of fine magnesium for pyrotechnic gel

the fear arose in the minds of CWS officers that any of our small incendiaries would probably pass entirely through the light Jap structures and bury in the ground before they would function. The most effective way to meet this new problem appeared to be the removal of the delay increment in the fuze of the M-74 bomb intended for use in Japan.

This was one of the most interesting problems met in the development of incendiary munitions. A large air-gun, which had been constructed from a World War I 155mm. Howitzer, was brought into play. Various kinds of roof structures were set up in front of it and M-74 bombs shot through them at fixed velocities. Several modifications of the fuse train, the booster charge and the ejection charge were necessary before the timing desired was obtained. Finally, a sufficiently fast acting combination was worked out and a bomb developed that when passing through a roof at a velocity of about 400 ft. per sec. would eject its load within four feet of the roof.

The next move was to find a filling that would withstand the terriffic shock of being ejected to the rear when the bomb was travelling at a speed of 400 ft. per sec. Pyrogel was found to meet the requirements. Again, just to make fire-fighting more difficult and to make reignition probable, white phosphorus was introduced into the munition in a plastic cup. About 6 oz. of it was loaded along with the 2¾ lb. of pyrogel.

The M-74 was clustered in the 500-lb. aimable cluster. A B-29 carries 40 such clusters, each of which holds 38 bombs,

making its load 1,520 bombs containing over two tons of Pyrogel and 570 lb. of white phosphorus.

Production was just hitting its stride when the Japs cried "quits." This did not occur however before the bomb had proved its worth as a fire starter.

All of the incediaries found targets in Japan. On some raids all five types that have been described above were carried. This was primarily due to the fact that our production facilities simply could not keep up with the Air Forces after the B-29 got into action. Neither the M-69 nor the M-74 saw action in Germany. The other three; the M-50, the M-47, and the M-76 500-lb. bomb, as well as the jettisonable gas tank, all added materially to the collapse of Germany.

The results of bombing Japanese cities with incendiaries are most impressive. They were an important factor in bringing Japan to her knees. Before the first atomic bomb was dropped on Japan approximately 160 sq. mi. of her leading cities, more than 100 of which were concentrated in five leading cities, had been destroyed by fire. How many more raids she could have withstood will always be a matter for conjecture. We do know that they had practically demoralized her urban life.

ART OF INCENDIARY

The art of incendiary attack was new to us when we went to war. The science of incendiaries was almost nil. We soon learned we could not *think* incendiary munitions; we had to build them step by painful step. And finally, we had to satisfy ourselves and others that they would start fires.

At the CWS Dugway Proving Ground in Utah a village of German and Jap houses was constructed. The NDRC took over the task of making these structures agree to the last detail with the originals in Germany and Japan. As an example of the care taken, the lumber was selected for type and exact moisture content, and the straw mats were flown in from the Pacific.

It was by bombing these buildings in the desert that we were able to see exactly how the small bombs functioned in enemy lands. It was from these tests that CWS was able to draw conclusions upon which to base its recommendations to the Air Force. No money was better spent than that which went into the construction of this little group of buildings in the wastelands of Utah.

No story of incendiaries would be complete without mentioning the conversion of the jettisonable gasoline tank of airplanes into fire bombs. Originally, pilots requested a means of igniting any gas left in their tanks when they jettisoned them over enemy territory. CWS developed such an igniter and put it into production.

Chemical Corps, U. S. Army

Loading shells with white phosphorus ingredient in certain fire bombs which makes fire fighting less attractive

The idea proved so popular with the Air Force that it was decided by them that a specific development be undertaken to convert the tank into an incendiary bomb. The CWS liasion officer at Elgin Field aided in the work and suggested an igniter different from the one mentioned above. The Technical Command officers completed the development and saw the igniter into production. They also worked out the proper formulation of napalm gel to go into the tank for proper spread and ignition.

The effect of spreading 165 gal. of burning gel over an area about half the size of a football gridiron is very impressive, even to one standing at a safe distance from the fire. The munition played an important roll throughout the last months of the war both in Europe and in the Pacific. No sooner had our planes found a place to take off from Saipan than mixing and loading equipment was set up for filling tanks to drop on the shore defenses of Tinian. The Japs fairly crumpled up under the attack, thus making the capture of Tinian one of the least expensive in American lives of the islands taken. All through the rest of the war these tanks were dropped by the thousands. This development of the joint technical action of the Army Air Force and Chemical Warfare Service development officers was one of the most popular with fighter pilots of both the Army and the Navy Air Forces brought forth during the war.

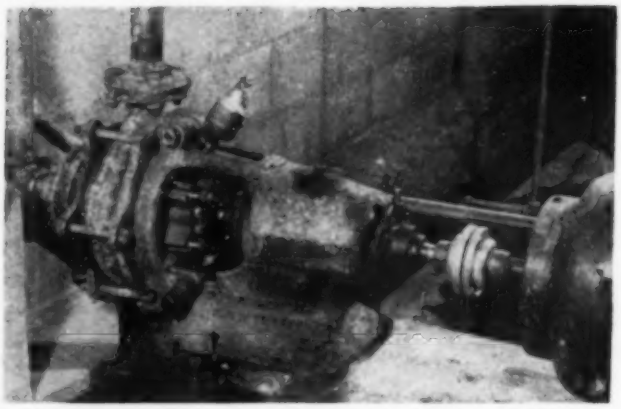
Testing M-69 incendiary bombs designed for use in the Pacific. Weight of individual bomb is about 6 lb.

Chemical Corps, U. S. Army

NEW ALLOYS
For Severe Corrosion Services

M. G. FONTANA

Professor of Metallurgical Engineering
Ohio State University, Columbus, Ohio



Chlorimet pump in fine-chemicals plant

Chemical engineers can add two new names to their list of corrosion resistant alloys. After three years in the incubator, Chlorimet 2, a Ni-Mo alloy, and Chlorimet 3, a Ni-Mo-Cr alloy, were this month put on the market by their creator, the Duriron Co. They are produced only as castings and are expected to find their biggest use as pumps and valves. Both are machinable, and one, Chlorimet 2, can readily be hardened by heat treatment.—*Editors*

THE DEFINITE trend in the chemical industry toward more severely corrosive conditions for plant processes has prompted an investigation of machinable high alloys with superior corrosion resistance and good mechanical properties. The data to be presented here were obtained on high nickel-molybdenum-chromium and nickel-molybdenum alloys. By high alloy is meant an alloy content of approximately 97 percent. Two of these alloys have been in production for almost a year; their commercial designations are Chlorimet 3 and Chlorimet 2.

These alloys are suitable for handling all concentrations of sulphuric acid, hydrochloric acid, wet chlorine, sodium chloride, hot acetic acid, bleach solutions and many other chemicals. Under severe corrosion conditions the presence of substantial amounts of ferric chloride may cause pitting attack. Indications concerning the use of these alloys can be obtained from the data presented below. For certain conditions the Ni-Mo-Cr alloy is better than the Ni-Mo, and for other conditions, vice versa, as indicated below. These alloys also possess good high temperature properties but discussion of this aspect is beyond the scope of this paper.

Table I—Nominal Compositions and Mechanical Properties of Chlorimets

	Chlorimet 3	Chlorimet 2
Nickel, %	60	63
Molybdenum, %	18	32
Chromium, %	18	nil
Carbon, %	0.07 max.	0.15 max.
Iron, %	2 (3 max.)	3 max.
Silicon, %	1	1
Manganese, %	1	1
Tensile strength, psi	75,000	80,000
Yield strength, psi	50,000	50,000
Elongation, % in 2 in.	10	5
Brinell hardness,		
Quench-annealed	220	230
Aged	220-300	230-475

DESCRIPTION OF ALLOYS

The nominal compositions and mechanical properties of the alloys in question are given in Table I. The data shown are for cast alloys. It will be noted that these are nickel-base materials. Detailed information on corrosion resistance and age-hardening is given below.

The recommended heat treatment for these alloys consists, briefly, of heating at 2,050 deg. F. for one hour per inch of thickness and then quenching in water. This treatment results in optimum corrosion resistance, machinability and other mechanical properties.

CORROSION RESISTANCE

The effects of heat treatment and composition on the resistance to pitting and the over-all corrosion resistance of the nickel-molybdenum-chromium type alloy are shown in Fig. 1. The over-all corrosion rate is plotted against the "quench-annealing" (Q. A.) temperature, or the temperature at which the specimens were heated prior to quenching in water.

The beneficial effects of high temperature quench-annealing are clearly shown in Fig. 1. The deleterious effects of tungsten and increasing carbon contents are also shown. The points marked ×, indicate that pitting occurred on the test specimens. All of the samples pitted in the as-cast condition but this observation is of little consequence since all castings are heat treated for commercial use. The interesting fact is that the low-carbon, low-tungsten alloy (tungsten not intentionally added) showed no pitting for any of the quench annealing temperatures. The higher carbon and tungsten bearing alloys showed pitting in all cases except for the 1,950 deg. F. treatment. This treatment, however, is undesirable because of the higher general corrosion as compared to more elevated temperature treatments.

Fig. 2 shows the effect of heat treatment and exposure time on the corrosion of the Ni-Mo-Cr alloy in boiling 3-percent sulphuric acid. The more or less constant corrosion rate in the last four periods is significant in that the acceleration of corrosion rate with time, often exhibited in stainless alloys, does not occur under conditions similar to those used for Fig. 2. Incidentally 6.5 mils per yr. (0.0065 in per yr.) is a low and "acceptable" corrosion rate insofar as service life on the basis of laboratory tests can be predicted.

Fig. 3 shows the effect of heat treatment on the corrosion resistance to hydrochloric acid and also the corrosion resistance of Chlorimet 3 to this acid over

Table II—Corrosion of Ni-Mo alloy (Chlorimet 2) by Hydrochloric Acid

Brinell Hardness	Heat Treatment	Corrosion Rate, Mils per Yr. 5% HCl Boiling	20% HCl Boiling
220	As-cast	22	34
230	Q.A. 2,050 deg. F.	24	13
240	Q.A. 2,050 deg. F., 92 hr. at 750 deg. F.	..	19
270	As-cast	31	28
320	Furnace-cooled from 1,550 deg. F.	..	38
300	Furnace-cooled from 1,450 deg. F.	21	45
460	Q.A. 2,050 deg. F., 8 hr. at 1,300 deg. F.	21	40
475	Q.A. 2,050 deg. F., 16 hr. at 1,290 deg. F.	..	34

its entire concentration range. Fig. 3 shows the necessity for heat treatment of castings for acid strengths of over 10 percent.

Fig. 4 shows the corrosion of the Ni-Mo-Cr and the Ni-Mo alloys by 10, 50 78 (60 deg. Be) and 93 percent (66 deg. Be) aerated sulphuric acid at 176 deg. F. For hot dilute sulphuric acid the Ni-Mo-Cr alloy is preferred. For hot intermediate concentrations of acid the Ni-Mo alloy is desirable.

The corrosive mediums used to obtain the data shown in Figs. 1, 2, 3, and 4 can be regarded as severe corrosion conditions and, in general, other types of commercial machinable alloys are not suitable for plant use under these or similar conditions. For example, plant experience has indicated the superiority of alloys of the Ni-Mo-Cr type over other stainless alloys for hot dilute sulphuric acid. The aggressiveness of hydrochloric acid from the corrosion standpoint is well known. The corrosion conditions used in connection with Fig. 1 are unusually severe.

Incidentally, corrosion tests in aerated 10 percent sodium chloride at 176 deg. F. showed no measurable attack on the Ni-Mo-Cr and Ni-Mo alloys. The specimens in these tests were wound with rubber bands to promote pitting, but no pitting was observed.

HARDENING

In some cases it may be desirable to use a hard corrosion resistant alloy for resistance to abrasion or erosion-corrosion (i. e., slurries or high velocities). Accordingly age-hardening of the alloys under discussion was investigated. Hardness is not necessarily a good criterion, but it is one of the best available at present for predicting resistance to the combined effects of wear and corrosion. Investigations are under way here on the erosion-corrosion of metals.

The cast Ni-Mo-Cr alloy shows little tendency toward age-hardening but some increase in hardness can be obtained. For example, aging for 15 hr. at 1,590 deg. F. resulted in a hardness increase from 220 to 280 Brinell.

The cast Ni-Mo can be age-hardened to about 500 Brinell. Maximum hardness is developed at an age-hardening temperature of 1,290 deg. F., as shown in Fig. 5A. Fig. 5B shows the effect of time at 1,290 deg. F. on the hardness. This low hardening temperature indicates that excessive scaling or oxidation of the alloy should not occur during the hardening treatment. Fig. 5C shows the effect of carbon content on the hardness of aged and quench-annealed material.

According to Ellinger (Trans. Amer. Soc. Metals, vol. 30, p. 607, 1942) the Ni-Mo alloys harden either because of precipitation of Ni_4Mo in the supersaturated nickel-rich solid solution or because of the decomposition of the supersaturated solution into two new phases, Ni_4Mo and Ni_3Mo.

The effects of aging and hardness on the corrosion resistance of the Ni-Mo alloy and other corrosion data are shown in Table II. The corrosion resistance in boiling 5-percent HCl does not change with hardness. In boiling 20-percent HCl there is little difference between the as-cast and hardened specimens, but the hardened material shows greater corrosion than the quench-annealed material.

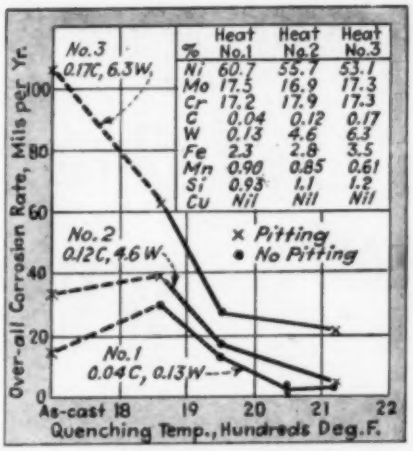


Fig. 1—Corrosion of Ni-Mo-Cr alloys (variations of Chlorimet 3) vs. heat treatment and composition (5-percent HCl plus 0.5 percent HNO_3. 158 deg. F., aerated)

HEAT TREATMENT

Except for applications requiring high hardness the optimum heat treatment for the Ni-Mo-Cr and Ni-Mo alloys consists of a quench-anneal from 2,050 deg. F. This treatment appears to produce best corrosion resistance and machinability. Higher temperatures are of no particular benefit as shown by Figs. 1, 2, and 3. The use of substantially higher temperatures would increase the cost of the alloys because of more rapid deterioration of the heat treating furnaces.

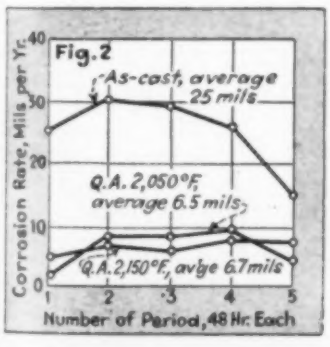


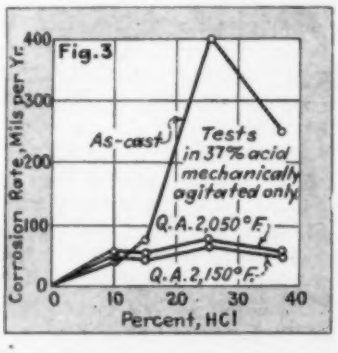
Fig. 2
Corrosion Rate, Mils per Yr.
As-cast, average 25 mils
Q.A. 2,050°F. average 6.5 mils
Q.A. 2,150°F. avge 6.7 mils
Number of Period, 48 Hr. Each

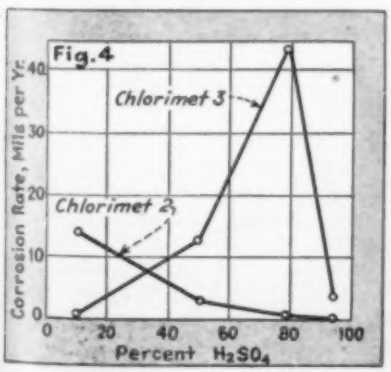
Fig. 2—Corrosion of Chlorimet 3 vs. heat treatment and exposure time (boiling 3 percent H_2SO_4)

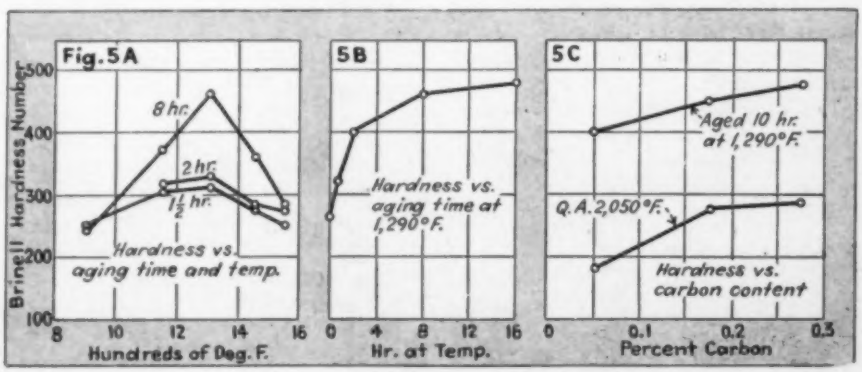
Fig. 3—Corrosion of Chlorimet 3 vs. heat treatment and HCl concentration (158 deg. F., aerated)

Fig. 4—Corrosion of Chlorimets 2 and 3 vs. concentration of HSO_4 (176 deg. F., aerated)

Fig. 5—Hardness of Chlorimet 2 vs. aging time, aging temperature, and carbon content







JOHN R. CALLAHAM, *Associate Editor, Chemical Engineering, San Francisco, Calif.*

New Chemical Industries Help Integrate WESTERN ECONOMY

The industrial economy of a nation or of a region can be no stronger than its chemical economy, for the chemical industries have become the backbone that supports and coordinates all industry. At the recent western convention of the American Institute of Chemical Engineers in San Francisco, new western chemical industries were highlighted to illustrate the progress towards industrial integration attained since 1940.—*Editors*

CLOSE TO 25 major industrial chemical products have been produced commercially in the West only since 1940. Processes for eight of these new western products, some of which are new to the entire country, are described briefly in this article. In addition, four new processes, all of which are firsts in the nation's chemical technology, are outlined.

SULPHITE LIQUOR ALCOHOL

Only plant operating in the United States to produce alcohol from sulphite waste liquor is that of Puget Sound Pulp & Timber Co. in Bellingham, Wash. Operations for DPC began in 1945, but for a year the plant has been selling its product to the peacetime market. The unit has operated at a capacity of 6,500 gal. of industrial alcohol daily; this rate may be increased.

Screened waste liquor from the sulphite pulping process, containing about 1.8 percent fermentable sugars, is stripped with steam to remove residual SO_2, which is reused in the wood cooking cycle. After another screening to remove any remaining fibers, the hot liquor is pumped to storage and thence to two flash coolers. Here it is cooled to a fermentation temperature of 30 deg. C. by vacuum evaporation, mainly by steam ejectors and barometric condensers. A concentration of the liquor occurs, amounting to 10-12 percent. Lime slurry is added for adjustment of pH; urea is added as a source of nitrogen for the yeast. The liquor is fermented over 12-20 hr. and then pumped to centrifugal separators to remove the yeast, about one percent by volume, which is returned to the first fermenter in the required amounts. Clarified beer, containing one percent alcohol by volume, is stripped in the beer stills. The alcohol is concentrated to 190 proof or higher in the rectifying column and is then fed to the purifying column.

Final products are alcohol, a low-boiling heads fraction, and fusel oil. Rate of production depends upon pulp output, some 22 gal. of alcohol being produced per ton of pulp.

COAL CARBONIZATION

Now beginning operations is the pilot plant of Coal Logs Co., Inc., in N. Salt Lake City to treat 50 tons of coal daily by a new low-temperature carbonization process (*Chem. & Met.*, March 1946, p. 186). Developed over seven years, it is designed to produce from Utah coals a smokeless fuel, coke, and unique types of coal tars by a method invented by K. L. Storrs.

A bed of slack bituminous coal 1-1.5 in. thick enters one end of a vibrated, horizontal retort of mild steel. Time of throughput is 1-3 min. Finishing temperature is 400-500 deg. C., at which point the coal can be compressed and extruded as cylinders of solid, smokeless fuel. A vacuum of 1-6 in. of water in the electrically-heated carbonizing chamber aids withdrawal of volatiles through pipes spaced horizontally along the retort. The partially-refined coal-tar fractions, each possessing distinct chemical and physical properties, are condensed without use of cooling water. In general, yields are 20-40 gal. of tars per ton of raw coal.

In the high-temperature furnace, still under development, previously formed "coal logs" will be fed continuously from the extrusion unit through a heated chamber to an end temperature of 800-1,000 deg. C. The product is a high-temperature coke. Time of travel, about 10-15 min., is correlated with the speed of the low-temperature furnace.

Unusual rapidity of heating results from vibratory agitation of the coal, which also reduces the energy requirements for carbonization. Temperature regulation is important. Design and operation of the furnace are simple. The solid fuel, utilizing natural cementing materials present in most bituminous coals, does not require blending or binders. Secondary decomposition of vapors within the retort is kept to a minimum, thereby producing greater yields of coal tars rather than high B.t.u. fuel gas.

ANHYDRIDE AND TARTRATES

The process and flowsheet used by Oronite Chemical Co. at Richmond, Calif., to produce phthalic anhydride from ortho-xylene was described in *Chemical Engineering*, August 1946, p. 116-119 and 138-141, and will not be repeated here.

By using the Metzner process for recovering alcohol, crude calcium tartrate and a soil builder or cattle feed from waste winery pomace, one plant recovered some 98,000 proof gallons of alcohol and 137,000 lb. of calcium tartrate from 4,000 tons of pomace resulting from the crushing of 34,600 tons of grapes. A number of plants using this process are now operating in the West, more are being installed.

SULFOLANE SOLVENTS

The sulfolanes are new solvents developed by Shell Chemical Corp. during the war. A semi-commercial plant for manufacture of dimethyl sulfolane was recently completed at Martinez, Calif. Starting material is 2-methyl-1,3-pentadiene which is reacted with SO_2 to give

This article is based on abstracts of 12 papers presented in the New Western Chemical Industries symposium, under the chairmanship of the writer, at the Western convention of the American Institute of Chemical Engineers, San Francisco, August 25-28. Authors of the individual papers are shown in an accompanying table.

2,4-dimethyl-3-sulfolene. This is hydrogenated to 2,4-dimethyl-sulfolane which is thus a derivative of acetone, by way of diacetone alcohol.

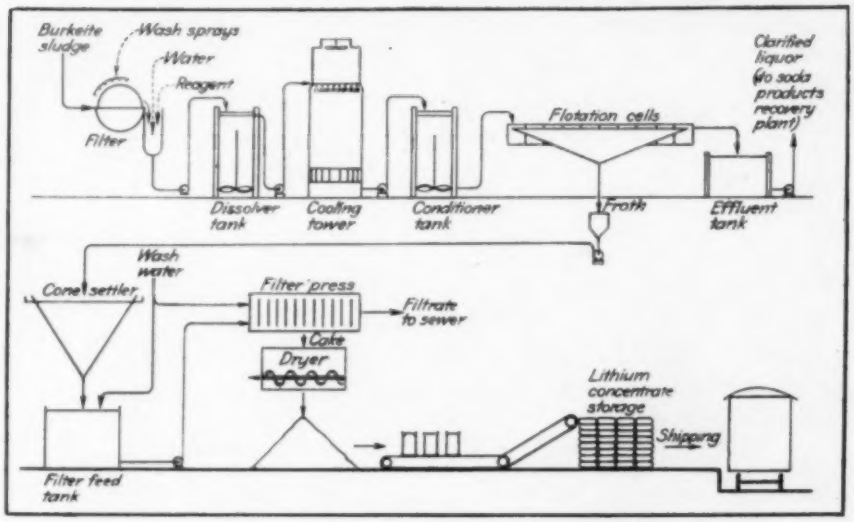
Diacetone alcohol is hydrogenated to hexylene glycol in an autoclave and batch distilled under vacuum. The glycol and catalyst are charged continuously into a dehydrator or reaction kettle. Methyl pentadiene, water and byproducts enter the dehydrator column, which returns higher boiling materials to the kettle. After separation of water, methyl pentadiene is batch distilled for purification and fed batchwise to an autoclave for reaction with SO_2. Dimethyl sulfolene is hydrogenated and periodically distilled under reduced pressure to purified dimethyl sulfolane.

Sulfolanes act as selective solvents for liquid-vapor and liquid-liquid extraction processes for separating mixtures of components having different degrees of saturation or of polarity. They can be used to separate aromatics from paraffins, naphthenes, and olefins and to desulphurize petroleum fractions. Highly selective for many compounds, they combine low corrosivity with chemical inertness. In addition, they can be removed easily from many mixtures by a simple water wash. Their disadvantage is that they are stable only below 240 deg. C. At higher temperatures, SO_2 is slowly liberated.

CARBOTHERMIC MAGNESIUM

In 1941, Permanente Metals Corp. installed at Permanente, Calif., the first carbothermic process in the country to produce magnesium metal. Before the war's end, the original single furnace installation had been increased fourfold and had produced some 9,500 tons of metal and 40,000 tons of special incendiary "Goop." The plant has been down for some months, but preparations are under way to resume operations before the end of the year. This will be the West's only producer of magnesium metal and the only unit in the country using the carbothermic process.

Meanwhile, research on streamlining the process and in converting batch sublimation of crude dust to continuous distillation is being concluded; these improvements will be incorporated into the modified process. The plant is expected to be a low-cost producer of magnesium metal.



Flowsheet of lithium concentrate recovery plant

POTASSIUM PERCHLORATE

Western Electrochemical Co. began commercial production of potassium perchlorate in Los Angeles during 1941, becoming the first West Coast producer and the second domestic manufacturer of this chemical. War demands skyrocketed the output, and in mid-1945 the firm began production at a second unit at Henderson, Nev., using part of the facilities of the former Basic Magnesium, Inc., plant. This unit had a capacity sixfold greater than that at Los Angeles. Potassium and sodium chlorates are now being produced at a rate 100 times greater than the original prewar installation to satisfy a world demand for this new West Coast product.

The chlorate process is continuous in contrast to the batch methods previously used, and the cells are of Schumacher design. The chlorate cells, having no diaphragms, are rectangular in shape and provided with iron cathodes and graphite anodes. Perchlorate cells, similar in design but operated on the batch principle, are equipped with platinum anodes.

LITHIUM

Lithium is present in Searles Lake brine to the extent of about 0.0115 percent Li_2O, equivalent to some two tons of Li_2O in the 17,500 tons of brine pumped daily to the Trona, Calif., plant of American Potash & Chemical Corp. for extraction of soda ash, borates and other chemicals. These two tons are equivalent to about ten tons of the final lithium concentrate, and this small amount is commingled with 4,500 tons of other salts. About three tons of lithium concentrate is now recovered daily.

The Searles Lake brine concentrate, containing about 0.2 percent lithium concentrate in suspension, is sent to flotation cells fitted with carbon bottoms of the finest available pore size. Air at 4-8 lb. pressure is introduced through the carbon plates. The concentrates are collected and settled in a cone bottom settler, leached, filtered, washed and dried. The dried crude concentrates analyze 19-21 percent Li_2O and constitute the highest known grade of crude lithium material ever placed on the market for use in producing lithium products.

PENICILLIN

Cutter Laboratories, Berkeley, Calif., is the sole producer of penicillin west of Chicago. Capacity of the plant, originally designed to produce one billion Oxford units per month by the flask culture method, is being increased to over 100 billion units monthly by using a different strain of mold and by fermentation in tanks of 5,000 gal. capacity. At present, the carbon-acetone and batch solvent extraction process is being replaced by a continuous counter-current solvent ex-

New Western Chemical Industries Symposium

Subject	Author	Firm
Historical background	Dr. W. Hirschkind	Great Western Div., Dow Chemical Co., Pittsburg, Calif.
Sulphite liquor alcohol	E. O. Ericeson	Puget Sound Pulp & Timber Co., Bellingham, Wash.
Coal carbonization	G. W. Carter	Coal Logs Co., Inc., Salt Lake City, Utah
Phthalic anhydride	Dr. I. E. Levine	California Research Corp., Richmond, Calif.[1]
Sulfolanes	H. G. Staaterman[2]	Shell Chemical Corp., San Francisco, Calif.
Pomace tartrates and alcohol	Dr. E. K. Metzner	Consulting Engineer, Azusa, Calif.
Magnesium	Dr. A. C. Byrns	Permanente Metals Corp., Permanente, Calif.
Potassium perchlorate	J. C. Schumacher	Western Electrochemical Co., Los Angeles, Calif.
Lithium concentrates	R. M. Mumford	American Potash & Chemical Corp., Los Angeles, Calif.
Penicillin	Dr. T. H. M. Taylor[3]	Cutter Laboratories, Berkeley, Calif.
Paraffin waxes	P. H. Huemmer	Union Oil Co. of California, Oleum, Calif.
Styrene	H. H. Smith	Dow Chemical Co., Gardena, Calif.
Phosphate-olivine fertilizer	Dr. R. W. Moulton	Manganese Products, Inc., Seattle, Wash.

[1] Plant of Oronite Chemical Co., Richmond, Calif. [2] Co-authors were R. C. Morris, R. M. Stagner and G. J. Pierotti of Shell Development Co., Emeryville, Calif. [3] Presented by Dr. K. S. Pilcher of Cutter Laboratories.

traction; anticipated results are distinctly greater recoveries with reduced costs.

Fermentation tanks are vertical, Inconel-clad steam pressure vessels equipped with inconel heating and cooling coils, a turbine-type agitator and a sparger for introducing air. Corn steep liquor, lactose, $CaCO_3$, $MgSO_4$, potassium dihydrogen phosphate, $NaNO_3$ and $ZnSO_4$ constitute the fermentation medium; pH is about 5.5. When the medium has reached the proper temperature, 150 gal. of mold spores are placed in the medium and sterile air at the rate of at least 400 cu. ft. per min. is introduced. After 2-3 days of fermentation, the liquor is cooled in a stainless steel heat exchanger to 2 deg. C. It is then run to refrigerated storage through a rotary vacuum filter, using a filter aid, to remove mycelia.

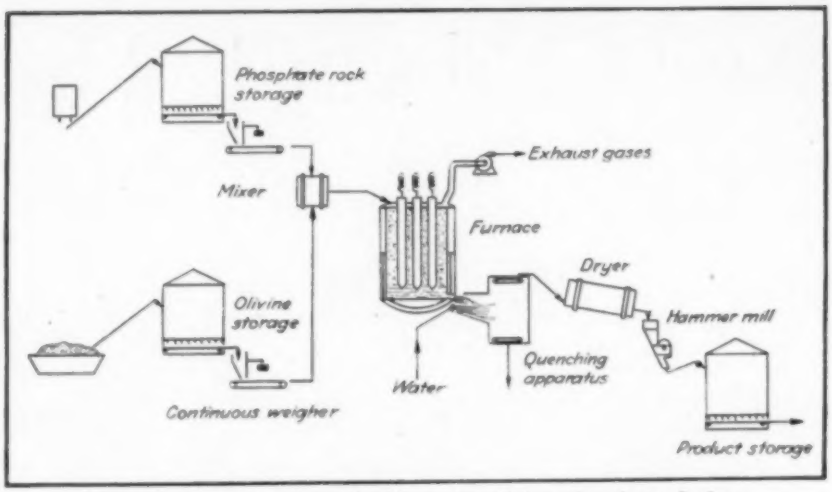
Penicillin from the crude liquor is adsorbed on activated carbon, 2-2.5 percent on a weight to volume basis. After 0.5 hr., the carbon slurry is filtered on plastic-coated cast iron plate-and-frame presses. The carbon with adsorbed penicillin, after washing, is eluted with an 80 percent water solution of acetone. Overall recovery of penicillin at this point is about 60 percent of that in the original fermented liquor. The penicillin-rich acetone and water mixture goes to a 3-stage vacuum spray evaporator system and is concentrated to a mixture of 0.5 percent acetone and 99.5 percent water plus penicillin. This is extracted batch-wise with amyl acetate, followed by chloroform at a temperature of 2 deg. C. The penicillin, now purified to about 950 units per mg., is fed to a flash evaporator operating at 0.1 in. Hg absolute and 40 deg. F. The purified water solution of penicillin is filtered through a bacteriological filter and dried either in final containers or in bulk.

PARAFFIN WAXES

Production of premium-grade lubricating oils from waxy California crudes by solvent extraction and dewaxing stimulated development by Union Oil Co. of California of a new process to refine crude waxes. The process uses methyl ethyl ketone as solvent. In 1941 the first commercial plant was put into operation at the firm's Oleum, Calif., refinery. This unit is the sole Pacific coast producer of fully refined waxes from crude waxes. The products are shipped throughout the United States and are exported.

Distillation of crude wax prior to deoiling occurs in a vacuum column with the two wax distillate streams as sidecuts. This produces crude wax cuts of the proper boiling range to give desired melting point waxes on deoiling and also removes asphaltic fractions. In deoiling, the crude wax distillate is chilled to crystallize out the desired fractions; MEK is then added as a solvent for the filtrate oil and uncrystallized low-melting waxes. The MEK-oil-wax slurry is filtered on a rotary, repulped with fresh solvent and then filtered again at about 68-75 deg. F. to give a wax less than 0.5 percent oil.

Solvent is recovered by distilling off MEK and steam stripping the wax and filtrate oil. Water is separated from the solvent easily since 90 percent MEK and 10 percent water forms a minimum boiling point mixture. Equipment includes two fractionating columns and a salt dryer, the latter reducing the water content from 10 to 3 percent by forming brine. The final step consists of decolorizing the deoiled wax fractions by treating with 3-10 percent activated clay at 300-325 deg. F. for about 1-2 hr. Spent clay is removed by a rotary precoat filter. Natural gas is bled into the system, since oxygen causes color degradation of the wax. The decolorized wax is steam stripped under vacuum to remove traces of odor or taste, and pumped to storage.



Flowsheet of phosphate fertilizer by olivine-phosphate fusion

LOS ANGELES STYRENE

The Los Angeles styrene plant, operated by Dow Chemical Co. for RFC, is one of six plants in that county built by the government for the buna S program. Products from these plants are converted to consumer goods in Los Angeles county, thus constituting the only group of synthetic rubber plants which transform raw materials to finished products in a given integrated area. The Los Angeles styrene plant is the only plant of its kind in the United States located in an area where both benzene and ethylene are immediately available from petroleum processing.

Designed for 25,000 tons of styrene yearly, advancements in catalysts and operational efficiency have allowed production to exceed this figure. Since the Batt Committee recommended that government styrene plants be sold to private industry, it is interesting to note the possible western utilization of styrene other than for synthetic rubber. Present West Coast demand for styrene appears to be about 500 tons monthly or about 25 percent of this plant's designed capacity. About 95 percent of this demand is for polystyrene and only five percent for monomeric styrene. It appears reasonable to expect a considerable increase in demand in the very near future. At present, there are no facilities at this plant for the manufacture of polystyrene. About 90 percent of the injection molding machine capacity on the West Coast is located in the Los Angeles area.

NEW-TYPE FERTILIZER

About two years ago, Manganese Products, Inc., of Seattle, Wash., became interested in producing a phosphate fertilizer by the fusion of olivine and phosphate rock. The method was first investigated by TVA researches. A pilot plant furnace of 200 kva. capacity was operated for about six months, turning out six tons of fused product daily. The company is now ready for commercial production, having purchased large deposits of olivine on Cypress Island, Wash., and opened up a phosphate rock mine in Montana. A former steel foundry in Seattle has been purchased, and a 2,500 kva. furnace has been installed.

Raw materials will be delivered to the plant crushed to -1 in., weighed and mixed in the correct ratio and fed continuously into the top of a 3-phase electric arc furnace quite similar in design to a carbide furnace. The melting zone at the bottom will be at a temperature of about 1,500 deg. C. Tapping will be intermittent. Molten slag will fall into a high-velocity water spray, since rapid chilling gives a product high in available phosphate (about 20 percent citric acid soluble P_2O_5). The granulated product is removed by a chain rake, dried and crushed through rollers for final sizing.

Complex Processing Used for Light Magnesium Oxide

ARTHUR Q. SMITH
American Gas Association
New York, N. Y.

Although it is a simple compound, light magnesium oxide presents a surprisingly complex series of processing steps in advancing from the dolomite used as the raw material to the finished product. These steps involve essentially: calcining, slaking, carbonation, separation by filtration, precipitation, thickening, filtering and drying, followed by calcination of the final product. Close control is needed to assure quality.—*Editors*

MAGNESIUM OXIDE is a common pharmaceutical and cosmetic ingredient, but one that has a complex and involved chemical manufacturing process. As made by the General Magnesite & Magnesia Co. it follows through a many-step process and does not appear as magnesium oxide until the very last stage of processing, which is a calcining operation in gas-fired kilns.

Oxide of magnesia powder, sometimes called "calcined magnesia," is a fine white powder of almost uniform particle size averaging ½ micron in diameter. The U.S.P. grades of oxide, both light and heavy, are extensively used for the manufacture of drugs and cosmetics. A special light grade which is very active chemically is designed particularly for the manufacture of milk of magnesia. This special light oxide weighs approximately 6 lb. per cubic foot.

The production of U.S.P. light magnesium oxide by the General Magnesite & Magnesia Co. in its plant at Plymouth Meeting, Pa., involves a difficult separation of the magnesia from the calcium compounds and impurities present in the basic raw material, dolomite. Approximately 6.5 tons of dolomite is processed for each ton of magnesium oxide produced. The processing is carried out in some 10 major steps.

Dolomite is calcined in vertical shaft kilns, using coke as fuel to give calcium and magnesium oxides according to the equation: $CaCO_3 \cdot MgCO_3 = CaO + MgO + 2CO_2$. The CO_2 resulting from burning the coke, together with the CO_2 given off in calcining the dolomite, is drawn through scrubbers, then compressed for use in saturating milk of dolomitic lime. Oxides of calcium and magnesium are slaked with an excess of hot water to give calcium and magnesium hydroxides according to the equation: $CaO + MgO + 2H_2O = Ca(OH)_2 + Mg(OH)_2$.

A thin suspension of the calcium and magnesium hydroxides in water is saturated with carbon dioxide to precipitate the calcium as carbonate and to dissolve the magnesium as bicarbonate according to the equations:

$$Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$$
$$Mg(OH)_2 + 2CO_2 = Mg(HCO_3)_2$$

The calcium carbonate is then separated from the magnesium bicarbonate solution by filtration. Production of U.S.P. magnesium oxide requires that practically all calcium, iron, and other impurities be removed from the bicarbonate in this way.

Basic magnesium carbonate is precipitated from the clear magnesium bicarbonate liquor by passing the liquor continuously through reaction vessels where it is heated almost to the boiling point by steam. This results in the following:

$$4Mg(HCO_3)_2 = 3MgCO_3 \cdot Mg(OH)_2 \cdot 3H_2O + 5CO_2$$

The CO_2 liberated in this process is returned to the scrubbers for reuse.

The thin suspension of magnesium basic carbonate is then converted to dry form by sedimentation, filtration, and drying. The magnitude of the operations can be imagined when it is realized that at least 16 gal. of water must be carried through the saturating, separating and precipitating operations, and eliminated in the concentrating operation, for each pound of magnesium oxide produced.

Dried magnesium basic carbonate is fed continuously to gas-fired horizontal rotary kilns where the carbonate is calcined to pure magnesium oxide by the gas flame in the kiln at 1,650 deg. F. The calcining operation requires about 4 minutes as the carbonate flows through the kiln continuously. The burners on these kilns use premixed gas at a 5 to 1 ratio, and consume per kiln 400 c.f.h. of 520 B.t.u. gas.

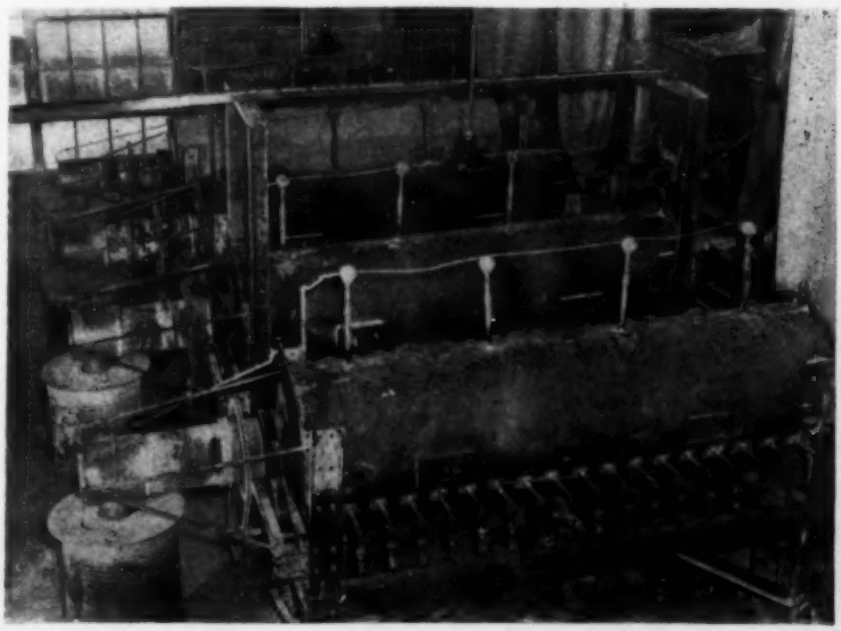
Temperature at the hottest point of a kiln is recorded automatically once a minute, and the amount of properly proportioned gas-air mixture fed to the burners is automatically increased or decreased to keep the kiln temperature constant. Temperatures at three other points along the length of the kiln are recorded once each minute by the control instruments.

The equation of this calcining process, which produces pure magnesium oxide, is:

$$3MgCO_3 \cdot Mg(OH)_2 \cdot 3H_2O = 4MgO + 3CO_2 + 4H_2O$$

After calcination the product is put through a pulverizer and into packages.

This battery of continuous gas-fired kilns is used in calcining the purified basic carbonate to yield the final light oxide



FROM THE VIEWPOINT OF THE EDITORS——

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L. B. POPE, R. W. PORTER, J. V. HIGHTOWER, E. C. FETTER, R. F. WARREN, Assistant Editors • R. S. McBRIDE, Consulting Editor

RATING THE CANDIDATES

Before each election CIO-PAC always gets out for its membership a list of the records in Congress of candidates for reelection. It evaluates from the standpoint of organized labor the way in which individuals have voted during the past year.

One wonders why the more conservative elements of America do not study these lists so that they also may exercise their judgment as to the worth of a candidate seeking reelection. The CIO lists have been widely publicized. It might not be a bad idea for engineers and scientists to look at them and form their own opinion on the basis of the record. Professional men have a responsibility in these matters quite as much as do unionized artisans.

PRINCETON'S FIRST 200 YEARS

This year what was once called the College of New Jersey celebrates its two hundredth birthday. It does that in a fitting way by bringing together in a series of conferences many scientists, educators, engineers and industrialists who are willing to think and talk in terms of the trends that may well characterize the future. Such a meeting during the early days of October dealt with the broad relations of "Engineering and Human Affairs," in which we were pleased to note a number of worth-while contributions from the chemical engineering profession.

Drs. C. M. A. Stine and C. R. Downs presented the case for more efficient utilization of materials, primarily from the chemical viewpoint. The former asked, "Can any of us say in the present stage of scientific knowledge just what is the most efficient way in which corn, wheat or cotton may be used? They may serve many projects as yet undiscovered. What is true of farm products is to a greater or lesser degree true of all products of our forests, mines and waters—in brief, to all of our natural resources. . . . We can grow more wheat, but we can't grow copper or iron. . . . The war just closed has taught us that no modern nation is stronger than its industry, and that no industry is stronger than its technical manpower. . . . Looking back on us, historians in some future age may well conclude that the world of 1946 was just emerging from the Dark Age of Science."

Dr. Downs concerned himself with the question of whether the more efficient use of raw materials, as devised by inventive peoples, might not eventually over-populate the earth. "Sooner or later," he said, "the facts of population increase must be faced. Do scientists and engineers have the answer? If they do not, the long-term future of man is not encouraging. It should be clear to all that political controls will be inadequate. Inventive peoples face a serious challenge to their continued existence. They cannot, and the United States in particular cannot, continue to export indefinitely their rainfall, soil fertility, fuel and fertilizer ingredients in the form of foods for the rest of the world in exchange for luxuries, and through the medium of questionable loans."

Dr. Zay Jeffries made a plea for the more efficient utilization of our metals. He warned that danger signals should be sounded now, even though the troubles will not reach an acute stage during the next few decades. America's industrial civilization is rich partly because we have so many metals with such varied properties. It is rich partly because the metals are available in vast quantities, the world's new metal production sometimes exceeding a hundred million tons in a single year. The rate of consumption is increasing, but cannot go on forever.

The greater use of aluminum and magnesium, which will probably assume a position second only to iron in both tonnage and value, will help to conserve the other metals. A greater future supply of some of the more abundant but less used metals and near metals would provide additional relief. And substitution of non-metallics for metals favors this conservation. These and other means can extend our supplies but as Dr. Jeffries pleads it is not too early to commence long-term planning.

Dr. R. E. Wilson reviewed incentives for engineering research—sharing a phase of that broad subject with Dr. Frank B. Jewett. In contrast with most scientific and industrial research, the engineering phase is a relatively neglected field. It is often particularly expensive and is not well adapted to university laboratories. There is need for rapid expansion in engineering research. Too much of our engineering design is still largely on an empirical basis. Hence, adequate incentives are especially important. The greatest incentives of all—as the petroleum industry has so well demonstrated—are the profits arising from improved technology which in turn results from research. "If the public can be made to understand the need for adequate incentives and opportunities for research, we will witness an era of scientific achievements which will dwarf that of the past."

Dr. Gaston Du Bois began his speech with this admonition: "Let us beware of selling chemistry short!" He traced the progress of chemical manufacturing methods as technology has spread so significantly to petroleum, rubber and other large process industries. "Technically speaking," he said, "the future is bright, very bright, but there is one dark cloud on the horizon. Germany lost the war, not because of any deficiency in scientific or technological progress, but because of a deficiency in moral and ethical progress. . . . The sign of moral greatness—respect for others—was lacking, and now that we are powerful, at least for a little while, we have to keep this in mind."

So it is that chemical engineers think of human affairs. It is an encouraging sign of the times, and we are indebted to the founders of Princeton for their thoughtfulness in providing this anniversary for us to celebrate so auspiciously. Congratulations to President Dodds and his virile staff! Best wishes for another equally productive century of progress.

MORE RESEARCH vs. STOCKPILING

Not much information is being released by the Army and Navy Munitions Board and other agencies engaged in the program for acquisition and stockpiling of strategic and critical materials for use in future emergencies. But certainly any such plans must take into consideration all raw materials from which aluminum can be produced.

While it may be practical to import high-grade bauxite from South America for stockpiling, the task will be tremendous and perhaps seriously handicap us in producing the vast tonnages of aluminum needed by our peacetime industries. This undertaking might be made unnecessary or at least partially reduced by further development of low-grade bauxite and other alumina-bearing materials, of which this country has an abundance. To be in a position to do so the federal agencies will have to continue operation of several of the government-financed demonstration plants built during the war to develop and improve processes for obtaining alumina from these domestic materials. Already many millions of dollars have been invested in these plants and some valuable data obtained. In all likelihood a small additional investment will suffice to prove or disprove these processes. Should any one or more of them turn out to be successful the money will have been well spent.

A SHORT-LIVED ECONOMY WAVE

Protests from heads of government agencies that "strict compliance" with the President's economy program would be "detrimental to the public interest," have forced restoration of many public works projects to the 1947 fiscal program. Thus at the end of September when President Truman's attempt to defer 700 million dollars of public works projects was only six weeks old, the pressure of bureaucracy broke the dam.

As a result, plans for industrial expansion and even maintenance, to say nothing of the housing program, will now compete with flood control, river and harbor improvement, reclamation, power development and highway construction. Efforts will be made, it is said, to postpone other projects which were not on the first deferred list. The degree of success which this substitution will meet seems rather slim.

We have here a sample of inconsistency which is hard to swallow. Business and administration leaders have long stated that production is what is needed to temper the inflationary factors and to absorb the tremendous backlog of consumer demand for nearly everything. The fact that this reversion to the original program of public works will make it that much more difficult to achieve a balanced budget this year should be of great concern to all taxpayers, both corporate and individual. Perhaps the timing of this announcement, just a little over a month before the first Tuesday of November, may be significant.

EDUCATION PAYS

Young men taken into war industries fresh from colleges throughout the nation proved the high value of the chemical engineering training provided by these institutions, according to Dr. T. H. Chilton, manager of the development engineering division of the Du Pont company. This statement, made at the St. Louis meeting of the American Society for Engineering Education, does not surprise us. We have long suspected that the Du Pont organization regarded college-trained chemical engineers with favor. It is important, however, that Dr. Chilton has made such a public statement.

In the first place, teachers of chemical engineering are encouraged by this recognition of their work. It is often true that well done jobs are taken for granted. Frequently it is the poor job that attracts attention, sometimes because the product is noticeably inferior and sometimes because of serious complications which result. Commendation for a good job is, therefore, very much in order.

In the second place, such a statement as Dr. Chilton has made will encourage the chemical industry, and others employing chemical engineers, to appreciate the valuable assets which they have in the form of trained chemical engineers. It will give new resolution to the employers' statements of need when addressing the local Selective Service Boards on the subject of deferment for their college-trained technical men. Surely the existence of a well-trained, well-manned chemical industry is the best foundation on which to build the military strength of the United States.

In the third place, this statement will encourage the chemical engineering students who are now at the beginning of their courses. It holds out a very real goal to the student because it shows an appreciation of his future value to industry. With years of intensive study in a course which is usually among the most difficult on engineering campuses, such a goal serves a very real and encouraging purpose.

We hope that many of Dr. Chilton's contemporaries and those who follow him will continue to inspire chemical engineering teachers to do the best possible job for the nation and its vital industries.

TO GET HIGH-GRADE PERSONNEL

New Navy research will require large additions to the present staff of scientists and engineers engaged by that department. About 4,000 such technologists are already busy but a still larger group is sought.

The Navy is adopting as one part of its plan for "attracting high-grade personnel" a series of graduate courses in science and engineering. Thus a young man who feels that he can not continue in graduate work on a campus can continue to make progress toward a doctor's degree while engaged in a full-time task by the Navy and paid a full-time salary. The Department of Agriculture has done this for some time. And in a small way the National Bureau of Standards also has its graduate courses.

Ambitious young men interested in government employment will do well to accept engagement where they can take advantage of such educational opportunities.

CHEMICAL ENGINEERING PLANT NOTEBOOK—

THEODORE R. OLIVE, Associate Editor

$50 CASH PRIZE FOR A GOOD IDEA!

Until further notice the editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the "*Chemical Engineering Plant Notebook*." The winner each month will be announced in the issue of the next month: e.g., the October winner will be announced in November, and his article published in December. Judges will be the editors of *Chemical Engineering*. Non-winning articles submitted for this contest will be published if acceptable, in that case being paid for at applicable space rates. (Right is reserved to make no award if no article received is of award status.)

Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are considered.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

SEPTEMBER WINNER!

A prize of $50 in cash will be issued to

G. J. O'CONNOR
Evans Chemetics, Inc.
Waterloo, N. Y.

For an article dealing with a reliable method of investigating channeling in extraction systems that has been judged the winner of our September contest.

This article will appear in our November issue. Watch for it!

August Contest Prize Winner

INEXPENSIVE REMOTE INDICATOR SHOWS LEVEL OF "LIFT" IN GAS HOLDER

J. A. JAFFE and L. H. CIRKER
E. I. du Pont de Nemours & Co.
Arlington, N. J.

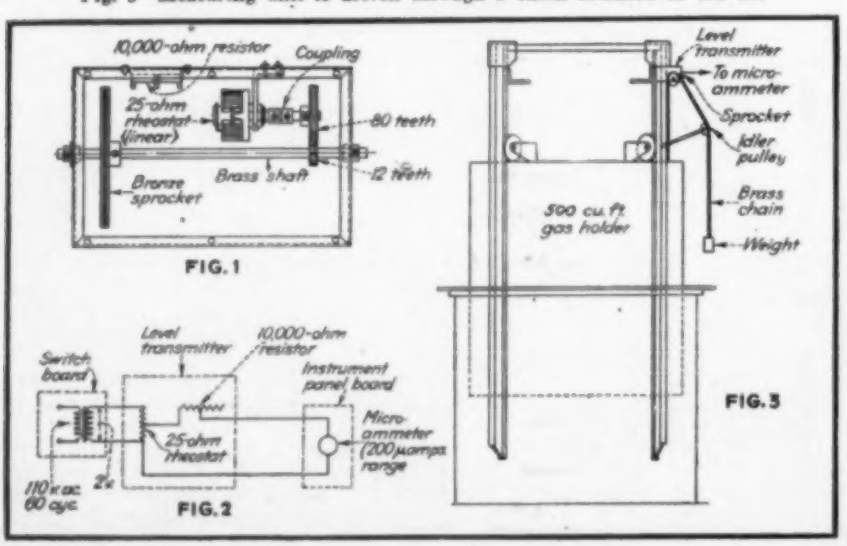
SKETCHES of a simple, yet sensitive, electrical instrument for transmitting and indicating the level of the "lift" of a gas holder are shown in Figs. 1 through 3. This particular instrument is designed for use with a 500-cu.ft. gas holder, but it is very flexible and with minor changes can be adapted for use with a gas holder of any size and capacity.

The transmitter unit is housed in a 9x5x6-in. metal box which is completely inclosed except for a small opening on the bottom through which passes a chain and sprocket. The unit is mounted on the gas holder at a point above the upper limit of "lift" travel. A brass chain loops around a 5-in. bronze sprocket fastened to a ¼-in. brass shaft inside the box and also passes around an idler pulley attached to the holder. One end of the chain is fastened to the "lift" while the other end is held rigid by hanging to it a small weight. Mounted in the metal housing on the same shaft with the sprocket is a small bronze spur gear which in turn meshes with a larger bronze spur gear coupled to the movable arm of a 25-ohm linear rheostat (approximately 300 deg.) for a vertical "lift" travel of 7 ft. The rheostat is connected electrically across the low-voltage winding of a 110/2-volt transformer.

Mounted on the instrument panel board is the indicator, in this case an a.c. microammeter (200 microamp. full scale). One side of the meter is connected to the center tap of the rheostat through a 10,000 ohm "Dividohm" while the other end connects to one side of the 2-volt winding of the transformer. The microammeter can be calibrated by tapping the proper resistance from the "Dividohm" to give full-scale deflection for maximum travel of the "lift."

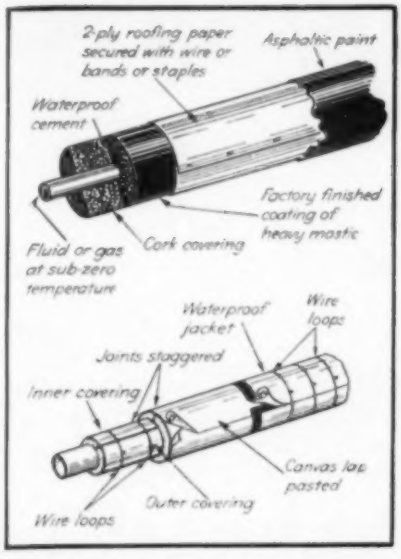
The cost of materials and labor required to construct and install the unit is less than $50. The instrument is sufficiently sensitive and accurate for use with any conventional wet-type gas holder, and as long as the two small ball-bearings are well lubricated, the instrument holds up well under outdoor weathering conditions.

Fig. 1—Variable rheostat is adjusted by height of holder
Fig. 2—Resistance is measured in terms of height by microammeter
Fig. 3—Measuring unit is driven through a chain attached to the lift



PROTECTING INSULATION FOR OUTDOOR EQUIPMENT

A RECENT issue of Armstrong's *Insulator* calls attention to the well-known trend toward outdoor plants in the process field and adds some pertinent information re



Typical insulation and protective covering for a cold line (at top) and for a hot line (in lower sketch)

garding the weather-proofing of insulation for hot and cold outdoor lines. It was pointed out that the protection of insulation is not quite so simple as is the protection of metal surfaces which usually need only periodic painting.

The job of protecting insulation on an outdoor line begins when the specifications are written. The actual application of the insulation is not much different from that of inside insulation, but it is necessary to use different finishes. Through the choice of proper materials there should be little need for other than routine, periodic maintenance.

TREATING COLD LINES

Several pointers for general use in outside insulation work were listed in the article. For example, such work should only be undertaken at above-freezing temperatures, preferably above 40 deg. F. In the case of cold lines, it was recommended that a single layer of two-ply roofing paper be applied with a 2-in. lap directly over the cork covering. It is necessary to make sure that the lap at all points forms a watershed, as in the illustration, and that all laps are sealed to prevent moisture penetration. The longitudinal laps should be secured with copper-clad staples and the whole assembly wrapped with No. 14 copper-clad wire on 9-in. centers. The covering should then be finished with a coat of cork covering paint. For fittings, the cover had best be protected with a weatherproof plastic type of coating, of painting or trowelling consistency. Several such materials are available.

The procedure for hot lines is rather similar. A heavy roofing paper, which may be a 45-lb. asbestos base paper if a fire resistant finish is needed, should be applied over the insulation with a 3-in. lap. The lap should be turned down, sealed and the paper wired in place with copper or galvanized wire on 4-in. centers.

THERMOCOUPLE SEAL FOR LOW PRESSURE SYSTEMS

SAMUEL F. CIRICILLO
Mechanical Engineer
Newark, N. J.

IT IS OFTEN desired in test work, where the temperatures are determined by means of thermocouples, to immerse the thermocouple directly in the fluid stream, in order that the response time of the thermocouple may be decreased. The use of wells, dry or those filled with a fluid such as oil, has been found to be lacking in sensitivity in systems where rapid changes in temperature occur.

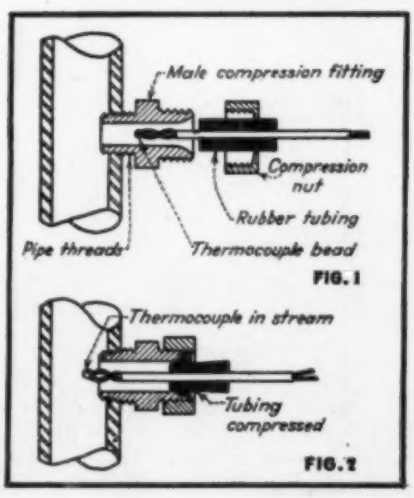
A simple and practical means has been found for utilizing standard fittings available in most plants and laboratories. In Fig. 1 the pipe carrying the fluid whose temperature is desired is first drilled and tapped with a ¼-in. pipe tap, in order to screw in a male connector which has a ¼-in. pipe thread on one end and a compression fitting on the other end. A piece of rubber tubing with an inside diameter large enough to insert the thermocouple leads, and an outside diameter slightly larger than the inside of the connector, is pushed through the nut as shown in the figure. The nut is then screwed up on the compression fitting. This compresses the rubber tubing and seals the opening between the tubing, the thermocouple leads, and the nut. Fig. 2 shows the rubber tubing fully compressed.

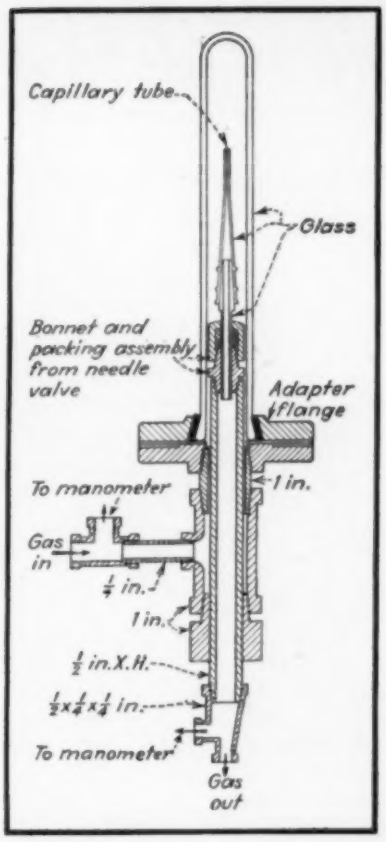
Care should be exercised in inserting the thermocouple in the tubing to insure the thermocouple bead being positioned in the center of the pipe carrying the fluid. Contact with the pipe would give erroneous readings of fluid temperature.

This type of seal has been found to withstand pressures up to 50 psi. and temperatures up to 212 deg. F. For higher temperatures, the rubber tubing should be replaced with synthetic tubing having the proper heat characteristics.

Fig. 1—Tubing adapter serves as a stuffing box for thermocouple leads

Fig. 2—Rubber sleeve is compressed to tightness against 50 psi.





This meter is safe for toxic gases to pressures as high as 100 psi.

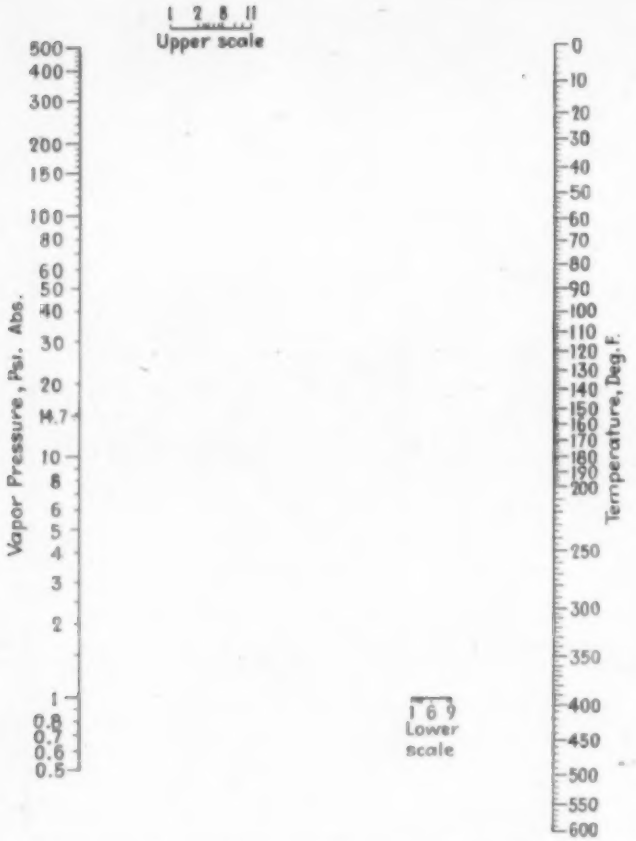
IMPROVED FLOWMETER FOR SMALL FLOW RATES

S. F. WILLIAMS
Stamford Research Laboratories
American Cyanamid Co.
Stamford, Conn.

IN THE accompanying sketch is shown a capillary type flowmeter which has been used successfully in these laboratories to handle toxic gases under several pounds pressure. The features permit: (1) Inspection of the capillary tube for fouling; (2) easy access to the capillary tube by the removal of four bolts; (3) rapid interchange of capillary tubes; (4) alteration of the flow range of a given capillary tube by cutting or drawing out the glass; (5) safety at operating pressures of 100 psi.; (6) reproducible positioning of the capillary tube; and (7) relatively leak-proof construction.

The particular flowmeter assembly shown was constructed of parts readily accessible and was connected by means of copper tubing to a Meriam U-tube manometer. The design may be elaborated to provide for all-alloy construction, for use of pipe instead of tubing to connect meter to manometer, or for use at higher flow rates by employing larger sized Pyrex pipe and other parts. Undamaged ends of broken Pyrex pipe may be employed for the bell, or 24-in. lengths of pipe may be purchased, cut in two and the ends closed.

Pressure difference across the capillary is that indicated by the manometer and this small pressure difference tends to force the ground glass taper joint together. This



This nomograph permits vapor pressure data to be obtained if vapor pressure is known for one temperature

Grouping of Compounds for Vapor Pressure Nomograph

Group	Upper Scale	Lower Scale
Aliphatic hydrocarbons The series C_nH_{2n+2}; also pinene, camphene and limonene	4	4
Aliphatic halides Mono- and poly-halogen derivatives of the series C_nH_{2n+2} and C_nH_{2n}, except acetylene tetrachloride	5	3
Aliphatic alcohols and ketones The lower members of the alcohol series $C_nH_{2n+2}O$ and $C_nH_{2n}O$. The saturated ketones of the series $C_nH_{2n}O$; the unsaturated ketones apparently are exceptions.	8	9
Aliphatic acids and esters The anturated acids of the series $C_nH_{2n}O_2$ where $n < 7$, and the esters $C_nH_{2n}O_2$ where $n < 6$	1	7
Aliphatic esters The saturated esters of the series $C_nH_{2n}O_2$ where $n > 5$; also acetoacetic ester; isobutyl oxalate; benzyl, linalyl, bornyl and menthyl acetates; bornyl propionate and n-butane; methyl, ethyl, n-propyl and iso-butyl benzoates; methyl salicylate	3	4
Aliphatic acids The saturated acids of the series $C_nH_{2n}O_2$ where $n > 6$ and the unsaturated acids of the series $C_nH_{2n-2}O_2$ from $n = 4$ to $n = 11$; also chloroacetic and benzoic acids	9	5
Alkyl benzenes The series C_nH_{2n-6}, C_nH_{2n-8}, and their ring halogen derivatives	6	3
Phenols The series $C_nH_{2n-6}O$ and m-chlorophenol	10	5
Aromatic alcohols The series $C_nH_{2n-6}O$ and their ring halogen derivatives	11	3
Anilines The series $C_nH_{2n-5}N$ and their ring halogen derivatives; also benzylamine	7	4
Alkyl naphthalenes The series C_nH_{2n-12} and their ring halogen derivatives	2	1
Silicon hydrides	1	8

same pressure difference exists across the valve bonnet packing and the threaded joint connecting it to the ½-in. i.p.s. pipe. When threading the valve bonnet into the ½-in. pipe, a tight sealing pipe-joint compound should be used to prevent leakage through the non-taper threads, due to the slight pressure difference across the bonnet. Careful brazing of the ½-in. pipe to the 1-in. bushing is required to center the axis of the valve bonnet in the Pyrex pipe.

In laboratory and pilot plant work where capillary tubes are to be interchanged between meters without re-calibration, it is desirable that the pressure drop through the meter body be negligible compared to the lowest reading to be taken with the capillary. In the meter shown, a flow of 0.1 c.f.m. is required to produce a reading of 1 mm. water when the capillary is omitted.

In calibrating these meters against various back pressures, better correlation has been obtained when they have been treated as orifice meters rather than capillary meters (See Whitwell, J. C., *Ind Eng. Chem.*, 30, 1157, 1938).

VAPOR PRESSURE CHART FOR ORGANICS

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SEVERAL advantages over the numerous vapor pressure charts that have appeared in the literature are encountered in the one presented here: The range and units of temperature and pressure are convenient for engineering work, the variety of materials covered is very wide, and only a single vapor pressure need be known for a substance in one of the chemical groups listed, in order to apply it. Moreover, the chart may be readily extended to other substances or groups of substances on the basis of quite limited data.

Its basis is the Cox type of chart described by Dreisbach[1]. If desired, the temperature scale may be extended by the equation $y=37.17x/(1+x)$, where $x=(t-32)/415$, and y is the distance along the temperature scale. The pressure scale is logarithmic.

If not even a single vapor pressure is known, and some rough estimate of the vapor pressure is still desired, the normal boiling point may first be computed from the structural formula of the compound[2, 3] and the chart then applied.

The chart represents the vapor pressures of members of the groups listed in the accompanying table. The boiling point or one vapor pressure must be known. Then, to use the chart, connect the upper and lower scale points of the group in question, and also the one known set of corresponding temperature and vapor pressure data. Pivoting about the intersection of these two lines will give the vapor pressure corresponding to any desired temperature.

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3. Gilman, H., "Organic Chemistry: An Advanced Treatise," page 1727 (1943).

PSYCHROMETER THAT FITS SMALL OPENINGS

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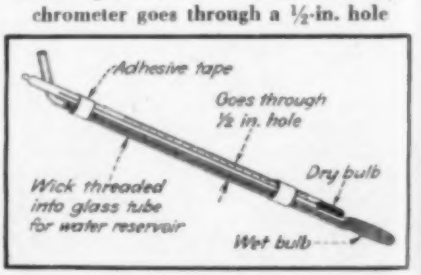
IN CHECKING dryer operation it was found convenient to have a psychrometer with an adequate water reservoir that would fit through a ½-in. opening. The wetbulb wick was led through a glass tube, as shown in the sketch, so that water would not run out if the device was tilted, and adhesive tape was used to bind the two thermometers and the glass tube together. The glass tube and wick hold enough water for over one hour of operation and a water bottle can be attached to the tube if use for a longer period of time is desired.

Including its water reservoir this psychrometer goes through a ½-in. hole



CHEMICAL ENGINEERING **REPORT ON.....**

ATOMIC ENERGY

Its Future in Power Production

The study presented here was prepared as a project of the Carnegie Endowment Committee on Atomic Energy. In cooperation with the Northern California Association of Scientists this organization, which is represented at the University of California by Prof. J. B. Condliffe, called together a group to consider the social impact of atomic energy. What follows is based on the material presented at the first four meetings of this informal committee, which was collected, checked and analyzed. The committee does not present the work as authoritative, but offers it merely as an analysis of information available at present, put into such a form that it can be used by engineers, research workers and administrators in the less technical fields. An acknowledgement should be made to the many members of the group both at the University and in various industries who have been helpful in preparation and criticism of the manuscript.

Once before recorded history of man it may be surmised that there existed a fearsome scourge. Sometimes it swept out of the mountains with the speed of the wind and a trembling of the earth; then again it sprang from the heavens with a thundering roar. It laid waste to vast plains and thick forests with equal facility. Man's carefully hoarded winter stores, his spare clothing and tools were all periodically destroyed, his game dispersed, and his family and tribe frequently lost in the flight. This enemy of early humanity was fire.

By the use of native intelligence this scourge was changed to a boon. By means of fire man survived the era of encroaching ice-packs. He went on to discover that fire was a useful medium for making bricks, for preserving food, and for refining and shaping metals. A more thorough investigation led to a quantitive understanding of the properties of heat and then to steam engines, stoves, steel mills, internal combustion engines, and other products of modern technology. Fire and the combustion of fuels have become the primary source of power. Fire, if it still destroys hundreds of millions in property annually, is an absolute necessity in the production of hundreds of billions in new income in the modern world.

We have enough understanding of history to venture a prediction that, in general, atomic energy will follow the same pattern—but on a much more condensed time scale. Fortunately, it is not now necessary to grope and fumble blindly for applications. Power is now a commodity in very active demand. With the release of atomic energy we have a source of power, available in almost limitless quantities, requiring only the expenditure of a certain amount of effort. We may ask how this effort compares with that used for our present sources which stem from combustion, falling water, or the sun. The answer is already apparent. Atomic energy just now is costly in terms of man-hours but, with the application of some of our accumulated know-how, the expense should decrease rapidly to the point where large installations will become economic. Quoting from a report of a large group of scientists advising the Secretary of War's Interim Committee on Atomic Energy:

"We have examined in some detail the technical problems of making available heat and power on the scale of present world consumption from controlled nuclear reactors. We see no significant limitations on this development, either in the availability or in the cost of the fundamental active materials. We see characteristic limitations and characteristic advantages in atomic power which make us regard it in great measure as a supplement to existing sources, and an incentive to new developments, rather than as a competitor, let us say, to coal or to petroleum products. We see no foundation in current science for the hope that atomic power can be effectively used for light, small portable units such as are required for aircraft and automotive transportation; but we believe that the development of rather large power units for heat and conversion to electrical energy is a program for the near future; that operating units which serve to demonstrate the usefulness and limitations of atomic power can be in existence within a few years, and that only the gradual incorporation and adaption of such units to the specific demands of contemporary economy will involve a protracted development."

For the industrial scientist and engineer the problem of harnessing atomic energy can be stated as follows: It is desired to transform random high-energy atomic and molecular motion into a form that is readily transported and utilized with as great an efficiency as possible. This differs from the thermal systems to which heat engines have been applied only in that the high energies involved may be of a million-fold greater intensity.

Originally heat engines were developed which transformed the expansion of gases into motive power that was transported throughout a small factory by shafts, belts, and pulleys. This was found, however, to be an inflexible arrangement and relatively inefficient. Then electric power was developed to the point where it became both the most readily utilized and the most easily transported form of power. Machinery for the transformation of thermal energy into electric power has been intensively developed. It is generally accepted that in the future relatively all stationary power demands, and a fair share of the mobile as well, will be filled by electric power.

Even the energy needed for heating of homes and offices may eventually be derived from electrical energy. In the last decade the cost of producing fuel has shown a constant increase, and heavy duty transportation costs have also risen. The trend is likely to continue. The net increased cost to the consumer is still very little, however, due more to technological advances in heating than any other single factor. But technological advances may easily lead as well to the electrically driven "heat pump". The transportation of low temperature steam or hot water to a city from an atomic energy plant for heating purposes would not be considered economical but the possibility of an efficient "heat pump," working on the opposite principle of a refrigerator, should not be neglected. A recent review (*Chem. & Met.*, June 1946, pp. 98-100) reveals that such systems are already useful in many phases of industrial heating.

Thus it is seen that electric power is at once the most versatile and the most easily transported form of power. It will supply efficiently almost every demand for stationary power. In the future, perhaps by the time atomic power becomes a major factor, it may be in a position to replace a large part of the fuel used for heating as well. Therefore, in considering atomic power development we shall concentrate on its conversion into electrical energy.

THE GEOLOGICAL APPROACH

Uranium is not a rare element. Its abundance in the earth's crust, as indicated in Fig. 1, is greater than that of silver, antimony, and mercury combined, these being metals which have been extensively mined and are now key components in our industry. Thorium is still more abundant than uranium.

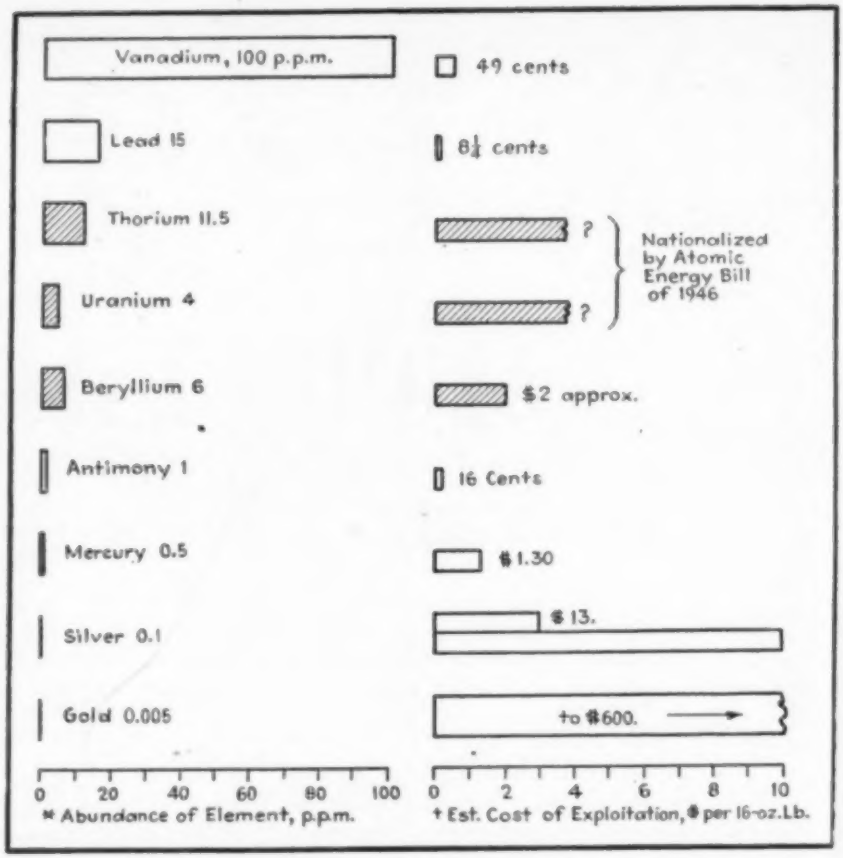


Fig. 1—Relative abundance and estimated exploitation costs of certain elements compared with uranium and thorium (* As estimated by V. M. Goldschmidt, *J. Chem. Soc.*, 655-73, 1937. † Based on approximate market prices in *Eng. Min. J.*)

This relative abundance is not closely related to availability, however. The uranium is locked up to the greatest extent in igneous rocks, among which it is sometimes found concentrated to a minor degree in pegmatites (coarse granites occurring in dikes and veins). Unlike many of the elements, uranium was not concentrated into rich ore bodies. Few of the known primary deposits contain uranium in sufficient concentration to permit commercial exploitation. The richer and more utilizable deposits have been formed through erosion of large volumes of igneous rocks and subsequent concentration by surface waters. Such concentration by natural means must be more than 1,000-fold before 5-20 lb. of uranium per ton of ore can be obtained, a range which would appear to be the lowest limit that is economical at present. To make things still more difficult, much of the uranium is intimately combined with other elements which are chemically and crystallographically similar (vanadium, etc.), thus adding to the effort needed to extract it from the ores. The value of vanadium and other byproduct metals is usually able to provide only a partial recompense for the extra effort involved.

Known workable deposits of uranium are scarce. This is primarily because the ores had no value until 1940 and were not sought by the prospectors. Recently there has been a flurry of reports relating to the discovery of new deposits in all parts of the world. However, from the existing knowledge of the origin of uranium deposits which is believed to be quite complete, new discoveries can be expected to diminish in size and number. Thus a generation or so hence we shall be facing the problems of developing medium- to low-grade ores, altogether not a catastrophic eventuality because we are considering here metals which have an intrinsic worth greater than the selling price of gold.

The more acidic light-colored igneous rocks, such as the granites and the rhyolites, have been shown to contain 10-20 grams of fissionable elements per ton (20-25 percent of which is uranium, the remainder thorium) while the more basic and generally older and darker igneous rocks such as basalt usually have only 3-8 grams per ton. This means that the world has now a huge reserve of fuel for power production. If 10 grams of the fissionable materials in a ton of granite were extracted and

"reacted" the resultant power would be equivalent to more than 40 tons of coal (see Table II). Since granite is one of the most common rocks on the face of the earth the supply of "low-grade ore" seems to be relatively limitless.

At present it is estimated that the mining costs for uranium should be in the neighbourhood of $2.5 per pound of metal in order to be economic and competitive with present sources. Since utilization in a pile requires scrupulous purity it is probable that the costs of additional refining may raise the total expense as charged to the power producing plant to around $5-10 per pound. These costs are based on the exploitation of presently known ore bodies, which in general are very limited in extent, so that the costs of fissionable materials are likely to go up gradually in the future. Allowing expenses of several dollars per gram it should not be difficult to work out methods for extracting fissionable material from granites or other low-grade, large-volume sources. As will be seen later a cost of several dollars per gram would barely affect the cost of power if one takes into account the fact that practically all of the fissionable materials introduced into a power pile probably could eventually be transformed into energy.

The sensible way to go about the utilization of uranium resources would be to set up a coordinated world-wide geological survey. This agency would plot out the most favorable areas for prospecting and investigating them in the order of their promise. Such a procedure would postpone the day that would require the development of means for recovering uranium from low-grade ores to a time perhaps 20 to 50 years hence. This should be a sufficient period for the normal process develeopment of new ore concentrating and refining techniques. One of the principal difficulties of large mines treating low-grade ores is power supply, an item which is likely to be high in cost due to the isolated character of many such deposits, but even this might be handled simply by the installation of atomic power plants.

It can be concluded then that the new resources of energy-yielding mineral deposits are sufficient to carry the human race through many centuries. No major difficulties are expected in the conversion of ore to refined metal.

THE THEORETICAL APPROACH

Fundamentally the problem of obtaining useful energy from fission reactions does not differ greatly from that of producing bombs. The reactions of neutrons and other sub-atomic particles are very much the same in both instances. The basic processes going on in a water-cooled pile such as that at Hanford are not greatly different from those that would go on at 1,500 deg. F. when using some other heat exchange fluid, and the same may be said for the chemistry of the separation.

The description which the research scientists have of the fission process for uranium and plutonium is quantitative and relatively precise. Briefly, it is stated that a neutron, preferably slow, combines with a U^{235} or Pu^{239} nucleus according to a known probability. This combination is followed almost simultaneously by a violent fission whereby two positively charged nuclei (whose composition is fairly accurately known) fly in opposite directions at tremenduous speeds and at the same time, according to the Smyth Report, between one and three neutrons are also released at high velocities. According to early sources the average number of neutrons released is in the neighbourhood of 2, 3 and 3.1 per fission. Collisions of the high speed fission fragments with neighboring atoms rapidly bring them to a halt and in the process the surrounding region acquires this energy in the form of heat. It is this heat which, when conducted out of the pile and transferred to a turbine by means of an expanding gas, is directly responsible for the power derived.

Practically all that physicists know about atomic nuclei is confined to their behavior at energies less than 100 million electron volts (Mev). The highest range of energies is so far attainable only in the largest cyclotrons and other nuclear apparatus as well as in fission itself. Until the present the reactions to be observed from the collision of particles with nuclei at still higher energies could be found only in the study of cosmic rays. Due to such remoteness and lack of control, man's fundamental understanding of highly energetic matter has come slowly. With the new nuclear apparatus now possible, some of which is already being built, energies of 200-500 Mev can be obtained. Thus it is possible to explore some new regions with results that are quite unpredictable, even with regard to atomic power developments.

The theoretical approach to power production, then, is an indirect one. The primary problem now for the mathematically inclined is one of developing a general theory for the behavior of atomic nuclei so that experimental data concerning fission, radioactivity, neutron capture, and other nuclear phenomena all fall within the framework of the theory. When such a theory is established (and published) it will be possible to carry out significant experiments with ease and a minimum of wasted effort. Such general theories are the lifeblood of applied scientific research and development. Intensive research upon industrial applications is expensive and therefore can hardly be carried out unless there is a good chance for success. Once there exists an acceptable general theory, then the large scale uses can be visualized, the economic prospects analyzed, and the workers and funds obtained. Without such basic theory research on applications becomes a gamble against great odds, and intensive efforts are usually unrewarding. The new processes and industries created are then limited in number and slow in development.

The possibility that some new series of nuclear reactions leading to power production may be discovered should not be ignored. This might come as result of the search for the general theory, but experimental techniques involving the use of such varied instruments as the cyclotron, betatron, synchrotron, and the linear accelerator, are becoming so advanced that the discovery of new nuclear reactions which would, in turn, aid in the development of the theory is quite possible.

ATOMIC POWER WHEN?

It is recognized that the first economic production of power from atomic energy may be as much as 5 to 10 years distant. This is a sufficient time to develop and test such a general theory if it is going to be at all tractable. (Some theories in science have proven to be very difficult to develop. The general field theory, for instance, has been attacked by many workers, including Albert Einstein, for several decades without much success). The hazard of a new, highly efficient process being discovered which would render obsolete all existing plants is a very real one as long as no general theory exists: once the theory has been developed and worked with for some years the chance of a complete revolution decreases substantially.

At present only uranium and plutonium piles can operate continuously in the production of power. It is indicated in the present stage of theoretical development that thorium, by a roundabout process, may be used as a primary fuel in conjunction with uranium and plutonium. The basic research on thorium however has not been released so that it is impossible to predict at present whether thorium fission can be used to advantage. It has been shown recently that 3-4 times as much thorium exists in the earth's crust as uranium and that as a fuel it is likely to remain relatively cheap for a longer period of time. It is difficult to say whether any fundamental data on the use of thorium needs to be obtained, but if such a situation exists it would certainly deserve the highest priority.

In summary then an analysis of the theoretical approach to power production leads to the following conclusions:

1. All possible encouragement must be given to the development of a fundamental theory of atomic nuclei.

2. The possibility of waste of capital due to premature obsolescence caused by revo-

lutionary advances in the science of nuclear physics is reduced once such a theory exists.

3. Owing to its much greater abundance, the way should be cleared toward the utilization of thorium in power piles. This may require only the release of information.

THE ENGINEER'S APPROACH

The fundamental problem of an engineer in atomic energy development is to put a theoretically sound and thoroughly tested process on an operable and economic basis. This will require new materials of construction and novel techniques for fabricating them. The materials and techniques used in present piles work, but in most cases they cost too much, and in many instances they are still highly inefficient. Improvement of design and construction is a lengthy and arduous task, one the should be embarked upon as soon as possible and with a highly coordinated staff.

The War Department is carrying out a part of this work. The sum of $2,500,000 has been authorized for the design and construction of the Daniels Pile which is to be the world's first high-temperature uranium pile. This project is reported to be primarily a means of testing out certain ideas of general pile behavior at high temperatures, and is not necessarily intended to be a pilot plant for future producing units. Engineers at Oak Ridge believe that the Daniels Pile will be in operation some time in the spring of 1947 and will produce some power by 1948.

For the purposes of simplicity the secondary power pile will be considered in detail, and the characteristics of the primary pile treated only if they differ in any respect other than magnitude. The distinction between the two types was first made by the Board of Consultants to the Secretary of State's Committee on Atomic Energy ("Lilienthal Committee") in "A Report on the International Control of Atomic Energy." This group, which was composed primarily of administrative scientists and engineers, carefully separated the "safe" from the "unsafe" activities. By "safe" they meant that the materials and methods could not be turned to military advantage, except by the construction of relatively large-scale facilities which could be easily detected by an uncomplicated scheme for inspection, allowing perhaps a one to three year warning preliminary to the outbreak of hostilities involving atomic bomb warfare. In any plant deemed "unsafe" however it would be possible to produce plutonium suitable for explosives on very short notice, or secretly perhaps by withholding part of the production.

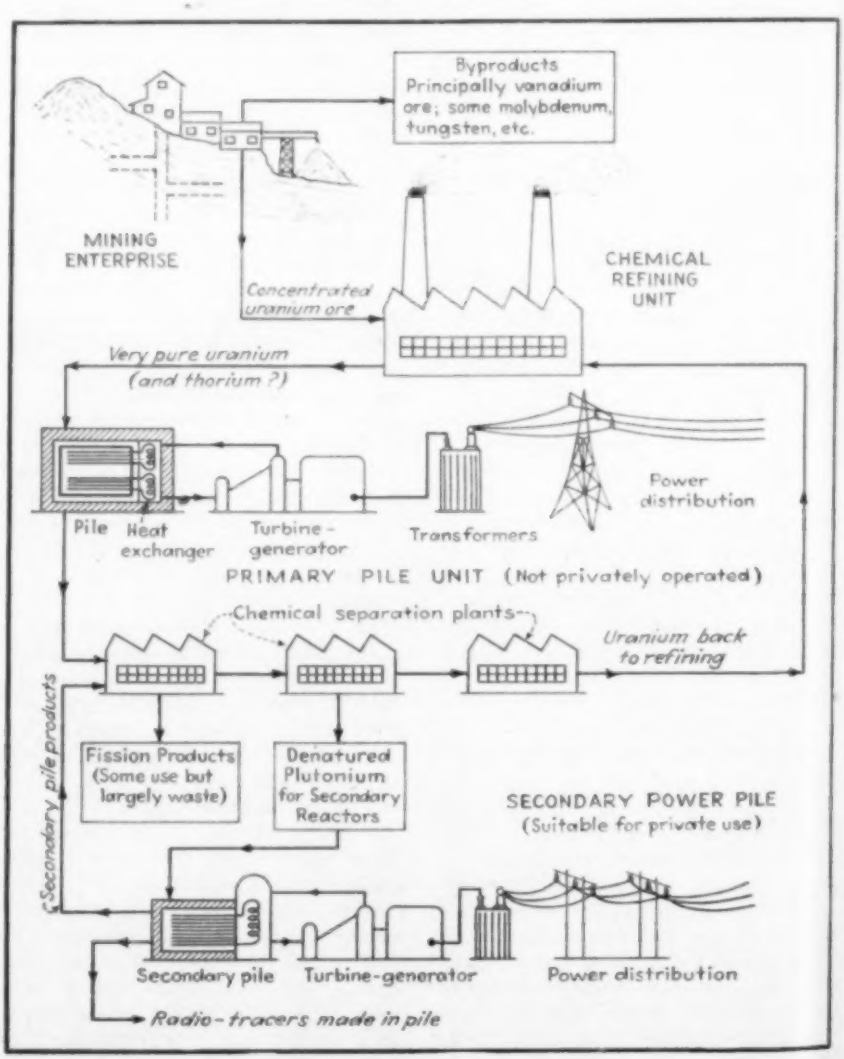
A high-energy plutonium reactor using denatured material was considered to be a "safe" activity, one which could be permitted to the various states and industrial concerns with only routine supervision and inspection. This reduces the political considerations in the location and operation of the secondary pile so that economic considerations may be emphasized. Before any installations are likely to be made they must at least give promise of producing either power or industrial tracers, or both, more cheaply than they can be produced by other means.

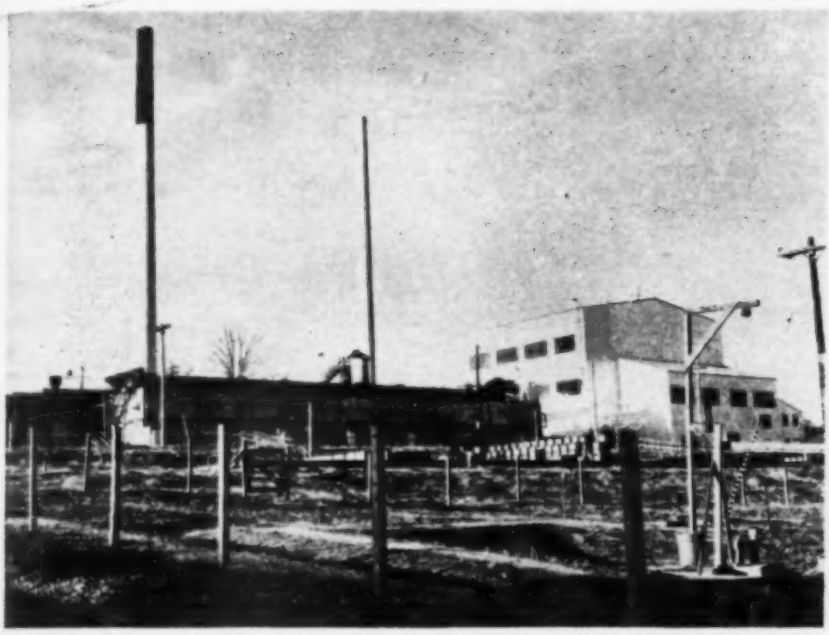
For this purpose design engineers (by necessity not connected with the Manhattan District) have taken all the available published information and tried to estimate very roughly the cost of installing these high-energy reactors as the thermal units in power plants of specified sizes. The large size (100,000 kw.) would provide sufficient power for a highly industrialized area including several hundred thousand people, whereas the small size (20,000 kw.) is sufficient for isolated operations such as mines, air bases, and newly developed agricultural areas.

The large size was envisaged to consist first of a thick shell of concrete and special insulating materials, perhaps 30-50 ft. in diameter, sunk in the ground. Then on the inside of this shell would be found a "tamper" or "reflector" which might be made of beryllium or some other material which does not lead to the loss of neutrons but causes a rapid reduction in their velocity. Next to the "reflector" possibly would be found a layer of chemicals so chosen that they would react with the stray neutrons from the reaction and form such radio-tracers as might be desired. In the interior, the pile itself, would be a mass of plutonium suitably protected from the heat it is expected to evolve, together with highly purified moderator which is intended to reduce the velocity of the neutrons produced by fission, and a heat exchange medium consisting of liquefied metal.

Preliminary calculations seem to indicate that the means employed in transferring the heat from the plutonium to the steam

Fig. 2—Idealized atomic energy industry in 195X, based on type of organization envisioned by control plan offered by United States to U. N. Atomic Energy Commission





Plutonium pilot plant at Oak Ridge where work leading to the experimental Daniels Pile has been carried out

which would actuate a turbine would determine the over-all dimensions of the interior. The design engineer at present appears to have two alternatives: (1) to pump around huge quantities of hot molten metal, or (2) to vaporize and condense a suitable metallic liquid. Both systems seem to have their difficulties but scientists who have complete access to the present knowledge of pile operation are confident that these difficulties can be resolved in a few years. In addition, machinery must be installed for loading and unloading of the plutonium and perhaps also for the occasional replacement of other parts of the pile.

Besides the reactor a considerable amount of accessory equipment must be present. A small chemical plant, operated by remote control, must dissolve the "burned out" slugs of plutonium and separate the metal by chemical means from the fission products. The unreacted plutonium then can be returned to the pile. The useful fission products would be separated there and the remainder disposed of. Waste disposal means were conceived as consisting of deep wells similar to natural gas wells, driven to a stratum where a suitable reservoir could be eroded out. Another alternative might be a pipeline to the bottom of the ocean, or some other stratagem of equivalent cost. Other plant facilities would probably be necessary to further process the tracers that would be obtained and put them into distributable form, but it is assumed that all such installations would be paid for by the sales of tracers, and would not be involved in the economics of power production.

The turbine then would be operated by steam, or perhaps by air, which was heated by being passed over coils containing the heat exchange fluid brought from the pile. In this manner it is hoped to minimize the problem of getting highly radioactive material inside the turbine which would tend to preclude any sort of repair and maintenance work. The turbine should be operated at more than 1,000 deg. F. if the highest efficiency were to be obtained. It is interesting to note that a turbine operated with plutonium fuel in such a manner as described would have a considerable advantage in thermal efficiency, that is, the ability to transform thermal energy into electrical energy. Since no large volume of gases is formed as a result of "combustion" in a pile, and losses due to radiation and convection are infinitesimal, it is obvious that practically no heat will go out of the chimney. Therefore an efficient plant should easily transform 40 percent of the heat units evolved into kilowatt hours.

The remainder of the downstream side of a power plant, that is the generators, transformers, etc., need not differ from the conventional when using atomic energy. The costs allowed for these items as well as the turbines are the same as those indicated for contemporary construction.

PRIMARY PILE

The design of a primary pile is more involved than that just reviewed for the high energy plutonium reactor. In present day designs the fuel of a primary pile would probably be an alloy of uranium and plutonium. Its principal process would involve the fission of U^{235} and plutonium, carried out in such a manner that the neutrons produced would create even more fissionable material than was destroyed. As a net result, then, both plutonium and power are the principal marketable products obtained, and pure uranium is the only raw material required.

Primary pile units must be relatively large in order to be efficient. This is made necessary by the operating and chemical processing equipment used, as well as the facilities for the disposal of wastes. The construction of a series of small plants instead of one big one would involve a multiplication of the most expensive facilities and therefore does not appear reasonable. These primary pile units would be expected to generate many hundreds of thousands of kilowatts of power when fully operated. At present it is estimated from the available data that for every 8,000 kw.-hr. produced from the primary pile at 40 percent thermal efficiency, 1 gram of plutonium could be separated. Because of the emphasis on plutonium production the number of stray neutrons available for the production of byproduct tracers in the primary pile would be at a minimum. Therefore, in the accounting analysis that follows, the value of tracers from primary piles has been neglected.

It is readily seen that the primary pile is a huge enterprise that must be carefully studied in every detail. It is also clear that if the problems of transforming efficiently the fission heat into electrical energy are to be solved for the primary pile, then the same problem will be solved for every plutonium reactor. In fact, practically every unit involved in the high-energy plutonium reactor is a special case of some larger, more complicated unit in the primary pile.

It can be concluded, then, that the most efficient approach to solving the engineering problems of atomic power is to organize a concerted effort toward developing the new materials, techniques, and components required for the primary piles.

THE INDUSTRIAL APPROACH

The engineer in industry must combine the various factors of capital, management, labor, technical skills, and location so as to obtain the most efficient possible producing unit. He is essentially a "planner" with an engineering background who is capable of bridging the gap between pilot plant and full scale production. Being given a scheme for the production of power such as has been described in the preceding pages he can then determine on what bases and under what conditions it is economic to construct an atomic power plant in the United States.

Starting back at the beginning with the mines, it was seen that no technical difficulties were involved. An intelligent procedure for the utilization of resources of fissionable materials was laid down and, if it is followed through, there is no reason to believe that the fuel in a form ready

to be admitted to the pile should cost more than $20 a pound for decades to come. If all or most of the uranium can be converted either into plutonium or into power, initial cost is unimportant. There is some prospect that a fairly large stockpile might be necessary in the beginning of a large program of industrial use (if present plutonium supplies are not available), but such a stockpile would be no obstacle either, because the demand is some years off. The major part of the task of developing techniques for refining uranium sufficiently was taken on during the war and satisfactorily solved. Thus the problems upstream of the primary pile are minor, and the details can be neglected in a survey of this sort.

A primary pile uses uranium as a fuel and produces quantities of fission products, power, and plutonium. The published information is in such a state that reasonable estimates of the various quantities of each of the products cannot be supplied. About all that can be done is to circumscribe these quantities within theoretical limits. Each item met in the primary pile will be taken up in turn and discussed with the aim of ascertaining at least the order of magnitude involved.

FISSION PRODUCTS

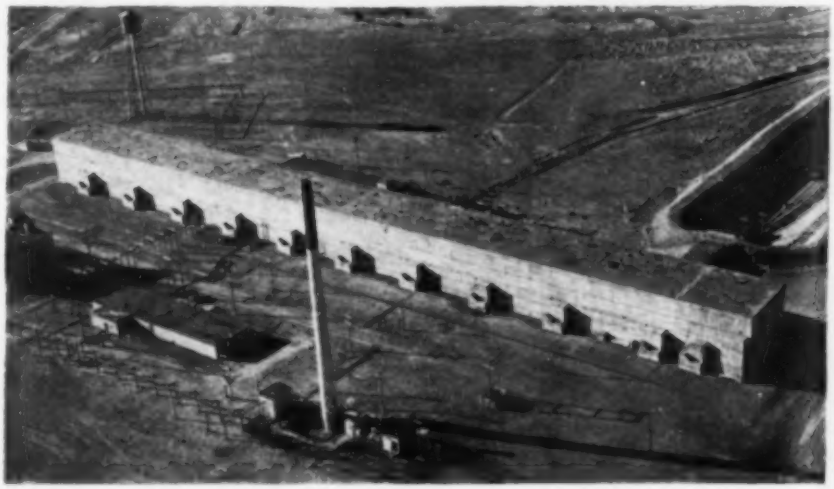
The amount of fission products formed is directly proportional to the energy evolved, about 1 gram of assorted radioactive elements being produced for every 8,000 kw.-hr. of electricity produced, assuming again that the power plant has about 40 percent thermal efficiency. In order to keep the plant operating effectively these fission products must be carefully separated from the uranium and plutonium in chemical plants operated by remote control. The identity of the principal long-lived components of the fission products has been recently revealed and they are slowly being made available to research laboratories. (See *Science*, **103**, 700, 1946.) At present only the elements with half-lives greater than a week or more can be considered as useful and marketable tracers.

In this classification of "useful tracers from fission products" are isotopes of the following elements: Zirconium, columbium, yttrium, cerium, barium, strontium, praseodymium, neodymium, europium, cesium ruthenium, tellurium, and iodine. Only two of the elements named, barium and iodine, have any widespread industrial or medical use, and therefore only their production and application should be expected.

It is worthwhile to estimate the maximum demand visualized for such a representative radio-tracer as I^{131}, which has a half-life of 8.0 days. Its application has been made in medicine where it is used in dosages of the order of millicuries, which means that several million people can be treated with a single milligram of radioactive iodine. If we should wish to go further than that and "tag" all of the commercial iodine in the world, a simple calculation using 10,000 disintegrations per second per gram of I shows that we should require less than a milligram per annum. Contrast this estimate of maximum demand with the several milligrams daily that could be produced by even the smallest power pile. It must be emphasized that radio-iodine is one of the most favorable examples that could be chosen among the useful tracers from fission products. Therefore, it must be concluded that there is no economic use for fission products that can be visualized today. Special uses of an as yet unpredictable nature should not be ruled out but it must be emphasized that no income should be expected to accrue from the sale of fission products.

On the other hand the highly radioactive elements formed in the fission process constitute a difficult disposal problems, which gives them what is usually termed a "negative value." The dissolution in acid of the uranium-plutonium alloys releases these deadly fission products in solid, liquid, and gaseous form, thousands of curies of radioactivity per day must be eliminated in such a manner that the personnel are not exposed to even a millionth part at any time in the process of disposal. Not only the operating personnel must be protected but all the population in the immediate neighborhood as well must also be considered. Food, air, and drinking water can be contaminated quite easily by improper design or by odd concentration effects occasionally found in nature.

So far only a few practical solutions to this problem have been suggested. A separation plant situated on an island or a peninsula would probably find it most practical ot pump the radioactive gases and solutions to the bottom of the ocean where they would diffuse into at least a cubic mile of sea-water. A separation plant situated in the plains or low hills probably would want to drill the quivalent of oil



Although not a true indication of equipment that would be involved in a primary atomic power plant, these views of units for plutonium at the Hanford plant, showing both the pile and the chemical treatment, suggest something of the magnitude of an atomic power project

wells to some point below an impervious stratum so that none of these waste products would be likely to diffuse into the drinking water. A plant operated in rocky, mountainous country would probably encounter the greatest expense since the operators of such a plant would probably have to seal the fission products in some shaft in the rocks. Thus it is seen that great premium will accrue to processes that have minimum waste volumes to dispose of, if such storage is necessary. All such suggestions for disposal would have to be carefully worked out to make absolutely sure there would be no slip-up.

The location of many atomic power plants is likely to be determined in large measure by the problem of disposal of radioactive wastes. When in proximity to the urban areas where large quantities of power can be distributed easily, such disposal must be investigated in detail. Desert or oceanside sites appear to have distinct advantage over any others, and therefore in countries like Denmark or Great Britain, where areas of high population density are surrounded by shallow seas and important fishing banks, it will probably be found difficult to establish first-class sites for atomic power plants.

BYPRODUCT TRACERS

It has been suggested that escaping neutrons which would ordinarily be absorbed in the shield surrounding the pile could be used in large part in nuclear reactions leading to the synthesis of radioactive "tracer" isotopes. There is a long list of such isotopes that could be so produced, many of which are likely to find considerable application. For that reason a jacket was installed in the suggested design of the power pile, which was to contain reagents adapted to capture the stray neutrons and thus be transformed into radio-tracers.

The promising isotopes that could be so synthesized are H^3, C^{14}, P^{32}, S^{35}, Cl^{36}, Ca^{45}, Ti^{51}, Cr^{51}, Fe^{55}, Co^{60}, Ni^{59}, Zn^{65}, As^{76}, Br^{82}, Mo^{99}, $Ag^{108,\ 110}$, Sn^{119}, W^{185} and $Hg^{203,\ 205}$. In each case the half-life is greater than a day and the element involved is important in industrial practice as well as in research. In fact, tracers can be applied to practically all large scale industrial-chemical operations except those involving only nitrogen, oxygen, magnesium, aluminum, and silicon, or any combination of these.

It is, of course, very important to know whether any of these tracer isotopes could be sold in large quantities at prices that would contribute materially to the income of the secondary pile. It is already obvious from previous arguments that medical and experimental uses will account for only a minute fraction of the amounts potentially available. A glance at industrial applications indicates that considerable savings in time, effort, and expense are likely to be discovered in applying tracers to separations and purifications of chemicals, a field that can be expected to expand very rapidly in the near future. Inspection of half-life data and production statistics reveals that C^{14} is likely to be a tracer isotope in great demand. Millions of tons of relatively pure organic chemicals are produced in the United States alone every year, and hundreds of millions of tons of carboniferous materials such as petroleum and coal tar are also processed. Allowing 2,000 disintegrations per minute per gram, at least a milligram of C^{14} is needed to "tag" a ton of organic materials. Thus there is a potential demand for several thousands of grams of C^{14} yearly if the price is reasonable enough. What this potential demand might look like is summarized in Table I.

Fine chemical producers would be quite willing to spend several cents per pound of product to be able to improve process control and purification with tracers, but their total demand could amount to only a few grams annually. Bulk organics could afford to pay a few tenths of a cent per pound of product, and petroleum refiners even smaller amounts than that. In order to get a mass market for radioactive carbon the cost of tagging should average $1 per ton of product. On such a basis it is possible to assign a value of about $1,000 per gram for C^{14} as introduced to the industrial process. Expense of incorporating C^{14} in the model compounds required for tagging is generally quite high so that an approximate value of $500 per gram can be given to the C^{14} as created by transmutation reactions in the jacket surrounding the secondary pile. The price as set by the Manhattan District, based on costs in small reactors in 1946, is about $400,000 per gram.

So far only the eventual demand for C^{14} and the sales price needed to induce such demand have been discussed. The supply factors have yet to be investigated. If it can be assumed that 10-25 percent of the neutrons produced will be utilized then it is possible to get some idea of the quantities of radio-tracers that can be produced in conjunction with power production. Calculations made on such a basis indicate that a power station of 100,000 kw. capacity might produce 100-1,000 grams of C^{14} per year. Thus it is likely to take several such plants to supply just the C^{14} requirements. It can be expected that quite a few more will be needed for others of the more useful tracers, such as the alloy metals. It can be concluded, then, that in the long term the demand for by-product tracers may easily become large enough to warrant their production in most high-energy plutonium reactors.

Table I—Estimated Potential Market for C^{14} as a Typical Tracer Element*

Industry	Industry Output, Tons per Year	Allowable C^{14} Cost per Unit of Product	Estimated Maximum U. S. Demand for C^{14} Grams per Year
Laboratory and medicinal	?	<$400‡	10– 100
Fine chemicals, pharmaceuticals	50,000†	1–10 c. per lb.	50– 500
Bulk organic chemicals	5,000,000†	0.1–1.0 c. per lb.	500– 5,000
Petroleum, coal tar processing	350,000,000†	$1 per ton	1,000–20,000

* Principal industry uses of tracers are expected to involve process control, purifications, separations, etc., but the development of demands for relatively large quantities is expected to be quite slow. Demand was calculated on the basis of a C^{14} half life of 25,000,000 years; recent information indicates that the true half-life is nearer 6,000,000 years so all demand figures should therefore be divided by four. † Approximate present annual output. ‡ Per mg. of tracer, not product.

ELECTRICAL POWER

A principal feature of atomic power is that approximately half of it must come in very large parcels. It has been already pointed out that primary pile units involve some fairly large scale chemical separations which must be carried out in equipment operated by remote control. The cost of such plants is not determined so much by the size of the vessels or equipment as by the nature of the control mechanisms required. A pile unit producing 200,000 kw. could not be expected to cost very much less than one producing 1,000,000 kw. The latter quantity is sufficient to supply a highly industrial area of several million people at present.

Since industrial regions are already equipped with large capacities for power generation, only very large population centers such as New York, Chicago, London, Paris, Leningrad, Moscow, Shanghai, Bombay, Calcutta, etc., could accommodate 200,000 to 1,000,000 kw. all at once. Such industrial regions usually have excellent transportation facilities so that other fuel costs are moderate, and power costs are correspondingly moderate. In the United States in such areas power seldom costs more than 5-6 mills per kilowatt-hour to produce, while distribution costs to small consumers are in general much higher.

The nations which will have primary pile units (an "unsafe" activity) will undoubtedly find it advisable to insist that they be very large units (both for political and for economic reasons), and that they be located at some isolated point near a large industrial area. On those bases such piles are likely to be of maximum use in the internal economy.

PLUTONIUM

In a 500,000 kw. primary pile unit about 250 kg. (550 lb.) of plutonium can be expected to be produced per year, according to data presently available. This plutonium would be suitably denatured and distributed for use in the independently operated secondary piles at a price probably around $20-50 per gram. The

latter figures can be arrived at by analyzing the conditions that must obtain before atomic energy systems can compete with conventional fuels as a source of electric power.

The survey of the industrial approach leads to the conclusion that uses for the radioactive fission products are likely to be negligible as compared to the amount probably available, and that the disposal of such fission products constitutes one of the site-determining factors. On the other hand, byproduct tracers appear to be marketable and are therefore worth considering as sources of income for secondary piles. It is also apparent that in order attain a reasonable cost per kilowatt of installed capacity, the primary piles must be very large units producing plutonium as a principal byproduct.

ATOMIC POWER COSTS

A close inspection of the data available for a study of the economics of power production from uranium indicates that certain critical items are missing. In order of their importance these are: (1) The cost of a primary pile unit, (2) cost of a high-energy plutonium reactor, (3) the value of plutonium, and (4) the value of the electric current produced. The last two are dependent in large part upon the values assigned to the first two, but the functions relating the items are complex and as yet indeterminate unless certain assumptions are made.

Ordinarily the procedure for determining the probable cost of power production is to make estimates of plant costs and fuel requirements, provide for operating and overhead costs, and allow for contingencies and taxes. This can be done very easily for coal fueled installations, using cost breakdown data, such as those presented in *Electrical World* (Dec. 2, 1939) and correcting the various items for subsequent price increases. Since atomic power plants differ principally in the thermal unit employed, a large share of the cost factors apply equally well to them. This breakdown of costs as applied to comparable plants in the United States is shown in Table II.

The sizes of power stations chosen for comparison are quite meaningful. The smallest, 20,000 kw., represents the minimum size for economic use of steam turbines in the United States. For quantities of electricity below this figure it is generally cheaper to employ diesel-electrical combinations. The 100,000 kw. size has been shown by prewar data to be well within the capacity range for most efficient power production in coal-fueled plants and therefore represents what are probably the lowest costs attainable in competitive plants designed in 1946. The 500,000 kw. plant size was chosen purely because it seems to be a reasonable compromise between efficiency and practicability.

Table II—Power Station on Cost Analysis*

Assumptions:
1. A plant factor of 50 (4,380 kw.-hr. per year per kw. installed capacity)
2. A utilization factor of 90 (peak load is 90 percent of rated capacity).
3. Costs are representative for present designs in the United States.
4. Designs of atomic pile units essentially as described, a *preliminary estimate*.

Plant Comparisons	Coal	Coal	Primary Pile	Plutonium Reactor	Plutonium Reactor
Capacity, kw.	20,000	100,000	500,000	20,000	100,000
Area, acres	2.0	10.0	(10,000)	2.0	2.0
Boiler room, cu. ft.	400,000	1,500,000	2,000,000	200,000	600,000
Turbine room, cu. ft.	200,000	900,000	3,500,000	200,000	900,000
Switchhouse, cu. ft.	50,000	500,000	2,000,000	50,000	500,000
Thermal efficiency, percent	25	35	40	30	40
Employees, number	25	60	200	20	40
Capital Costs (Dollars)					
Land and improvements	60,000	600,000	(2,000,000)	60,000	100,000
Bldgs. (exclusive of piles)	1,000,000	3,000,000	8,500,000	700,000	2,000,000
Pile units and accessory facilities	.....	.....	(24,000,000)	(1,160,000)	(2,000,000)
Fuel handling & storage	.....	2,000,000	200,000	.....	100,000
Condensing supply	.....	250,000	1,500,000	.....	250,000
Waste handling	.....	100,000	1,000,000	.....	100,000
Boiler plant	1,000,000	1,500,000	7,500,000	600,000	1,000,000
Draft system	.....	200,000	.....	.....	.....
Feedwater system	.....	400,000	2,000,000	.....	400,000
Piping system	.....	500,000	2,500,000	.....	500,000
Heat recovery apparatus	.....	250,000	1,000,000	.....	250,000
Turbine-generators and auxil. equipment	670,000	2,400,000	10,000,000	670,000	2,400,000
Switchgear & wiring	250,000	1,200,000	6,000,000	250,000	1,200,000
Switching yard and equip.	300,000	800,000	2,500,000	300,000	800,000
Total	3,280,000	13,200,000	68,700,000	3,680,000	11,100,000
Operating Costs (Dollars)					
Fuel†	360,000	1,000,000	100,000	270,000	1,000,000
Wages and salaries (at $4,000)	100,000	240,000	800,000	80,000	160,000
Maintenance and supplies	30,000	120,000	1,000,000	40,000	150,000
Fixed charges (15 percent)	490,000	1,980,000	10,300,000	570,000	1,660,000
Total cost per year	980,000	3,340,000	12,200,000	960,000	2,970,000
Cost per kw.-hr.	11 mills	7½ mills	.....	.....	.....

* This cost schedule is adapted from ELECTRICAL WORLD, December 2, 1939.
† Based on coal at $6 per ton, uranium at $10 per pound and plutonium at $20 per gram.

The cost of the thermal units of atomic power plants, along with the requisite accessory facilities, is quite unknown because, so far as we know, no designs have yet been completed so the only figures inserted have been ones that seemed "reasonable" considering the complexity of the chemical operations involved. However, other of the unknown factors such as value of power are pretty closely determined by competitive systems of power production so the conditions for entry of atomic units into the power production field can be indicated if a price for power equal to that obtained from a typical coal-fueled power station of the same capacity is assumed.

INCOME ESTIMATES

Some of the data of Table II for primary piles and plutonium reactors are repeated in Table III, together with estimates of income producible by sale of power, plutonium and tracers. Several conclusions can be drawn immediately from these summations of income. (1) The most obvious is that the sale of tracers does not contribute greatly to the income derived from the operations of a pile for power purposes. In fact, small units in isolated regions would probably not consider the matter unless C^{14} was worth much more than $500 per gram, as was assumed above. (2) The excess of income over operating costs (5-15 percent) indicates that atomic units of what is considered a "reasonable" expense would tend to displace many coal-fueled units. On such a basis industrial power would cost 5-15 percent less than competitive units using coal at $6 per ton (26,000,000,000 B.t.u.) if plutonium were valued at $20 per gram. (3) It is also apparent that there will always be difficulty in apportioning costs to plutonium and power, the two principal products of a primary pile. According to the American proposal to the United Nations, such plants would be operated by an Atomic Development Authority whereby the Authority would wholesale the power to nearby communities and would auction off or otherwise distribute the plutonium to smaller reactors operated independently. How much of the cost of production shall be assigned to electric current? The figure of 4 mills taken here represents a compromise between present urban industrial power costs and those obtained in the most efficient hydroelectric projects. This allowance yields plutonium, then, at a cost per B.t.u. somewhat less than that of coal as an article of international commerce.

Actually, in a situation where both coal and plutonium are competing as fuels for electric power production, the deciding fac-

tor will be the cost of the atomic unit which replaces fuel storage facilities and furnaces. Taking data as scheduled in Table II, it is possible to estimate the value of plutonium as a fuel, as a function of the cost of the atomic unit. Such estimates appear in Table IV which shows that the "breakeven" point for the cost of a 20,000 kw. atomic unit is about $1,500,000, while for a 100,000 kw. unit this point is approximately $6,000,000. Since the true ratio of costs of the respective units is less than two, based on the judgment of engineers, it seems likely that in regions of more or less constant fuel costs (seaboard areas and along rail trunk lines) the use of plutonium will lead to the use of fewer but larger power installations. The most economic size of station for power production is expected to jump from an average of 80,000 kw. in 1939 to something like 150,000 to 200,000 by 1960 if atomic energy is applied to any extent at that time.

The tendency of the larger size units to be more efficient is borne out by a comparison of the competitive values of coal and plutonium as in Table V, assuming otherwise all the data presented in Table II.

Tables IV and V should be very useful in making surveys of the applicability of atomic power to particular localities in North America and Western Europe, where the market price of coal and other fuels is known and where adjustments in plant costs can be estimated. However, when considering less developed areas where interest rates are much higher, Tables II to V inclusive must be reworked before final judgment.

Table III—Estimates of Earned Income For Atomic Power Plants

Plant Comparison	Primary Pile Unit	Pu Unit	Pu Unit
Capacity, kw.	500,000	20,000	100,000
Ann. power prod., kw.-hr.	2,190,000,000	87,600,000	438,000,000
Op. costs (est.), $	12,200,000	980,000	2,970,000
Value of power, mills per kw.-hr.	4	11	7½
Income			
Sale of power, $	8,800,000	965,000	3,290,000
Sale of plutonium, $	5,000,000 (250 kg.)		
Sale of tracers, $		50,000	250,000
Tota	$13,800,000	1,015,000	3,540,000
Income above est. costs	$1,600,000	$35,000	$570,000

Table IV—Plutonium Value in Marginal Reactors

20,000 Kw. Plutonium Reactor		100,000 Kw. Plutonium Reactor	
Cost of Atomic Unit	Pu Value	Cost of Atomic Unit	Pu Value
$800,000	$27	$1,000,000	$34
1,100,000	24	2,000,000	31
1,500,000	20	4,000,000	25
2,000,000	14	6,000,000	19
2,500,000	8	9,000,000	8

Table V—Plutonium and Coal as Competitive Fuels for Power Generation

20,000 Kw. Station ($1,100,000 Atomic Unit)		100,000 Kw. Station ($2,000,000 Atomic Unit)	
Coal Price	Pu Value	Coal Price	Pu Value
$3	$11	$3	$21
4	15	4	25
5	20	5	28
6	24	6	31
8	33	8	38
10	42	10	44
12	51	12	51

PRIMARY PILE ECONOMICS

One aspect of the subject has been discussed already in relation to the valuation of plutonium. There are many other question, some as yet unanswerable.

The problem of the over-all demand upon uranium and the size of the effort required for its extraction is worth considering. In Tables II and III it may be observed that a yield of only 550 lb. of plutonium from an original 10,000 lb. of uranium was assumed. An approximately equal weight of fission products would be formed so that the overall efficiency of uranium use assumed is only about 11 percent, the remaining 89 percent going out with the wastes. The process need not be so inefficient but, even if it were, only 10 tons of pure uranium per year would be required to supply 10 percent of the power that is used in the United States. A production of 10 tons, or even 100 tons per year would not strain our resources for some time to come.

The chemical separation plants in the primary piles may actually be fitted out to reprocess plutonium from the nearby secondary piles and thus eliminate the need for many small reprocessing plants as was assumed in cost estimates. This presupposes the ability to move highly radioactive materials safely and cheaply, a situation which may be at hand. Certainly, if small reactors are adapted to ships and submarines, it would be to their advantage to have such equipment available in all the principal ports. If such an hypothesis proves practical, then the production cost estimates of electric power from atomic fission should be reduced a few percent further in the more accessible locations.

The responsibility for construction and financing of primary piles is also very much beclouded. Since they can, almost on an instant's notice, be converted to the manufacture of plutonium suitable for the assembly of atomic bombs, the manner of operation is a matter of international concern. Who shall work out the plans for primary pile installations and develop the final design? Who shall decide the financial arrangements and who select the people that determine operating conditions? These questions must be answered to the satisfaction of all the world, otherwise the development of atomic power can only mean a preparation for destruction. Scientists at Oak Ridge who have studied the matter for many months have expressed the opinion that any development of atomic power possibilities is "too dangerous" an activity to be engaged in unless there is complete agreement on the international scene.

Since, as noted before, the technology of the primary pile is the least known step in the engineering picture, and since it has been represented as being the most dangerous socially, the subject of primary piles merits the concentrated attention of physical and social scientists, engineers, and statesmen alike. Beyond the technologist there are other engrossing questions yet awaiting study. The student of international relations will want to study the possible effects that air transport of plutonium may have on foreign trade. Public administrators will probably want to know the probable outcome of various policies of power distribution. The sociologist would like to discover the effect of cheap electricity on retarded cultures. The problems, especially the economic and administrative ones, are many. The time, estimated at 5 to 10 years, is yet sufficient to make a fair start. If the facts are at hand and the fears of warfare sufficiently allayed, it is possible that atomic energy may be the first worldwide development to be approached rationally.

In this report it was intended to summarize the significant scientific and technical information that is available now, and to present it in such a form as to encourage other studies especially with reference to social aspects of the subject.

CONCLUSIONS

Cost data produced concerning power stations of 20,000 and 100,000 kw. capacity using plutonium and coal as fuels, have been broken down to show probable differences in efficiency. Similar information for primary piles operation has been put on a comparable basis. If "reasonable" construction costs are assumed, it appears likely that plutonium reactors may produce power for 5 to 15 percent less than can be done in competitive coal-fueled plants. Hence, we have made an analysis of the possible competition between coal and plutonium, assuming a wide range of costs for the plutonium reactors. The large primary pile could probably sell plutonium at a price equivalent thermally to coal, and still produce power at a cost of 3-4 mills per kilowatt-hour. Above all, however, it appears that most careful planning of such operations on an international scale is absolutely essential.

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U.N. Report on Atomic Power

This is a condensation of the report on nuclear power presented on September 7 to the United Nations Atomic Energy Commission by Bernard M. Baruch, the United States representative. The report, prepared by Richard C. Tolman, scientific adviser, was based on a study made under the supervision of Charles A. Thomas, vice-president and technical director of the Monsanto Chemical Co., and director of the Clinton Laboratories at Oak Ridge, Tenn., which is operated by Monsanto. In this work Dr. Thomas had the assistance of M. C. Leverett, C. R. McCullough, L. W. Nordheim, W. I. Thompson, A. M. Weinberg, E. P. Wigner, and Gale Young, members of the Clinton Laboratories staff, and of C. J. Colley and F. G. Gronemeyer, of the Monsanto staff at St. Louis.

Since no nuclear power plant has yet been built the report is necessarily tentative, but, being based on the best available information, it is believed by its proponents to be authoritative. The study was made to show whether or not nuclear power costs at present can be sufficiently low to encourage development by industry. Although a number of types of nuclear power plants were considered, it was decided for purposes of the present cost analysis to base the work on a modified Hanford-type pile since more information is available for this type than for any other.

The commercial pile considered in this study would differ from the Hanford pile both in the fact that the operating temperature would be high enough to supply power and in the fact that the plutonium formed would be recovered for later consumption in the pile. On this account several changes in design and operating technique would be necessary, and an extensive research and development program would be required. Although the problems are difficult, they are said not to be insurmountable. The contemplated plant would include not only the pile itself, but all of the auxiliary equipment needed to operate a continuous thermal power unit.

Based on prices now current, it is believed that a plant designed according to these ideas could be built for a capacity of 75,000 kw. in a normal locality in eastern United States for about $25,000,000. Assuming that the plant would operate at 100 percent of capacity and that interest charges on the investment would be 3 percent, the operating cost of the plant is estimated at 0.8c. per kw.-hr. A conventional coal-fired power plant could be built under the same conditions for $10,000,000. Assuming that coal of 13,500 B.t.u. cost $3.50 per ton at the mine, and $7 per ton delivered at the power plant in eastern United States, then cost of power in the plant would be about 0.65c. per kw.-hr., again assuming 100 percent of capacity and 3 percent interest charges. With coal at $10 per ton delivered, the cost of coal and nuclear power would equalize.

Commenting on these data, the report reminded its readers that to achieve these costs would require successful solution of a number of difficult technological problems, but that future development should materially reduce both investment and operating costs for a nuclear power plant. The report claimed that about 55 percent of total operating cost in a coal plant is represented by fuel, and that the delivered coal cost mentioned, based on high quality fuel delivered in the latter half of 1946 in the eastern part of the United States, might well increase, while at the same time nuclear power costs might decrease. It was anticipated that nuclear power plants might make feasible a greater decentralization of industry since only a trivial amount of fuel need be brought in and large cooling water supplies could be eliminated through the employment of suitable gas turbines. Compared with hydro plants, nuclear power plants have the advantage of being able to supply process and heating steam directly, in addition to power. In consideration of this fact and the ability to decentralize nuclear plants, it is anticipated that more economical industrial combinations should develop.

Despite the great usefulness of radioactive isotopes, it was anticipated that the sale of these products would have little effect on economics of power generation.

Other factors bearing on the future economics of nuclear power suggested by the report included ability to employ nuclear power in isolated parts of the world where fuel costs at present are prohibitive. The possibility was suggested that nuclear power plants, used in conjunction with gas turbines, might be desirable as both operating and standby units for existing utilities. However, it is anticipated that a comparatively small standardized nuclear power plant can be developed, and it is believed that such plants placed at strategic points in established utility systems will greatly reduce power transmission costs. Owing to these factors, it seems probable that nuclear power will find considerable industrial application if obstacles are not placed in the path of its development.

HOW DATA COMPARE

Editor's Note—The report of the California scientists on the preceding pages was prepared before the appearance of the United States report to the U. N. Atomic Energy Commission and was of course worked up without the benefit of the confidential information available to Dr. Thomas and his group at Oak Ridge. It is interesting therefore to note the many similarities in viewpoint expressed by the two groups, as well as some of the dissimilarities in conclusions regarding costs. In the latter respect, however, note that the bases are not directly comparable, since the Thomas report postulated coal and atomic plants of 75,000 kw. capacity, while the California group based its estimates on a primary pile of 500,000 kw. and on secondary reactors of 20,000 and 100,000 kw.

It seems likely that the comparatively high cost of 8 mills per kw.-hr. reached in the U. N. report comes from the choice of too small a capacity for a primary plant. It is difficult to say what the optimum size for such a plant would be, but it seems obvious that it would be considerably larger than 75,000 kw., since a large part of the cost comes from special instruments and controls, which would not vary a great deal with the size of the plant. It seems likely that a 500,000 kw. plant could produce power for 3 to 4 mills per kw.-hr. but it must be appreciated that the distribution area of a plant so large would be enormous, and much of the saving would be lost in transmission. Probably the optimum size of plant for a system similar to that outlined by Thomas would be in the range from 150,000 to 250,000 kw., as compared with 60,000 to 100,000 kw. for coal. It is probable that if we were to compare both coal and atomic plants of optimum size we would find them immediately competitive, and that the atomic plant would have the advantage in the long run.

Regarding plant cost, the difference estimated in the Thomas report between coal and atomic plants is significant, since it appears to represent substantially the cost of a pile and its accessory chemical separation plant. The $15,000,000 difference is further of interest in that it should not vary a great deal with the size of plant.

Where the Thomas report suggests that coal and atomic power will be competitive at a coal cost of $10 per ton at the plant, the California group lowers this figure, on account of the larger plant chosen, to about $4 to $6. Even at $10 it would appear that the cost of atomic power should be of interest in many parts of the world where coal costs are higher than in the United States. In England mining costs are reported at $8 to $13 per ton, and still increasing. In the Channel countries $7 to $10 per metric ton is estimated currently. Miner productivity in Russia is admittedly very low, despite wages as high as for skilled mechanics, and coal cost may be as high as the equivalent of $20 per ton. It is clear that there is a great incentive in Europe, especially in Russia, to develop atomic power.

PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

GAGE VALVE

FOR USE on pressure vessels where it is necessary to remove the gage occasionally for inspection or maintenance, without interrupting operations, Jerguson Gage & Valve Co., Somerville 45, Mass., has developed the new No. 64 gage valve which is provided with a union connection to both the gage and the vessel. Construction is indicated in an accompanying illustration. To remove the gage, the two valves are merely closed and the union connection to the gage unscrewed. Thus there is no need to interrupt operations.

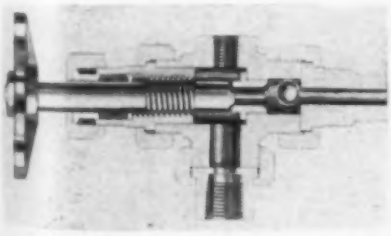
HIGH SPEED DISSOLVER

FOLLOWING commercial tests for the last five years in the chemical, paint and plastics fields, The Cowles Co., Cayuga, N. Y., has introduced a new high-speed dissolver which is currently available in two types. The new machine is said to have proved from 2 to 20 times as fast as other equipment on standard dissolving and dispersing operations. It employs a new method of introducing components of laminar flow and interface shear which is said to expose broad areas of molecular contact between solvent and solute, thus subjecting every particle to molecular tension and scrubbing action. In fact, it is claimed that high viscosity actually improves the shearing effect, resulting in faster dissolving or a more homogeneous mixture. The equipment is ruggedly designed, provided with antifriction bearings and is explosion-proof. One type has the tank permanently incorporated in the unit, with capacities of 100 to 500 gal. The second type, shown in the accompanying illustration, has an elevating head, designed for use with user-furnished portable tanks.

RADIOACTIVITY COUNTER

A COUNTING RATE of 100,000 counts per minute in the making of nucler measurements is said to be possible with the new Model 101 Scaler, an electronic counter offered by Atomic Instrument Co., 164 Charles St., Boston, Mass. The device incorporates a pulse amplitude discriminator in the input circuit which allows only pulses greater than a predetermined amplitude to operate the scaler. Pulses occurring as close together as 5 microseconds are individually recorded. The output circuit is adapted to the operation of various types of electro-mechanical impulse registers. The instrument is said to incorporate rugged construction that insures continued accuracy of operation, even when subjected to adverse operating conditions. It weighs approximately 40 lb. and operates on a standard lighting circuit.

Union-connected gage valve



REFRIGERANT GAS CONDENSER

LOWEST practicable head pressures at the compressor are said to be possible in refrigerating systems at all times when use is made of the new Aero-Pass condenser, manufactured by Niagara Blower Co., 6 East 45th St., New York 17. This condenser provides for automatic year-around operation. The apparatus consists of two condensing coils, the first a dry coil which is air cooled to lower the temperature of the gas close to the point of condensation; the second, a water-sprayed coil in which evaporative cooling of the gas takes place, causing condensation of the refrigerant. Cooling water is recirculated, the only makeup being that consumed by evaporation. Induced draft fans are used for air circulation. The condenser employs this company's "balanced wet-bulb control" which automatically adjusts operating conditions by means of the amount of air recirculated within the unit. An electric heater in the water reservoir is provided to prevent freezing during winter while with sufficiently low air temperatures the fans and sprays are automatically shut off and the water feed line drained.

NOVEL BUTTERFLY VALVE

COMPLETE shut-off is said to be attained in a new rubber-seated butterfly valve introduced by R. S. Products Corp., Philadelphia 44, Pa. The rubber lining, which is produced in the form of a loose sleeve or spool, shown being inserted in the accompanying view, is made of a flexible but extremely tough rubber suitable for service in the temperature range from —20 to + 300 deg. F. This spool fits somewhat loosely within the valve body and permits the rubber to bunch up around the entire periphery of the vane, as well as at the shaft-bosses, which are the critical points, thus making a perfect seal, according to the manufacture. The valve is said to have been tested rigorously, both in the laboratory and in service. For example, a manufacturer of powdered glue who tested the valve 9,000 times found a perfect closure still secured at the end of the test.

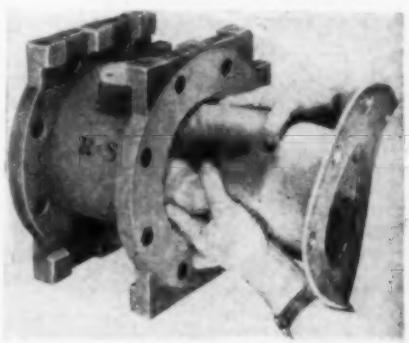
Incidentally, the rubber flange ends of the spool, which are bored corresponding to the bolt holes, serve as gaskets and eliminate the cost of additional gaskets. The valve is built for pressures in a range from 15 to 125 psi., using 125-lb. standard American flanges.

Elevating-head type dissolver

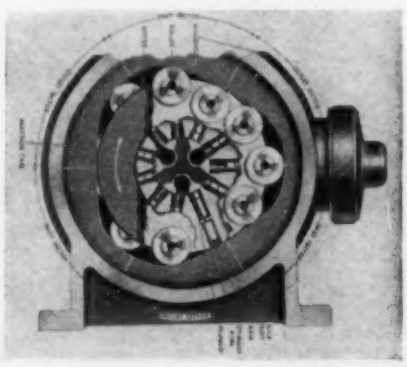
HYDRAULIC MOTOR

EXTREMELY small size in proportion to its power output is claimed for the new 47-hp. Superdraulic Triport hydraulic motor recently announced by Superdraulic Corp., Dearborn, Mich. This motor, only 10½ in. in diameter and light enough to be

Rubber-lined butterfly valve



Cross section of Superdraulic motor



easily handled by one man, is said to combine high starting torque with turbine-smooth power resulting from the fact that it provides 66 power strokes per revolution. The motor is available in two types, one rated at 26½ g.p.m. with 3,500 psi. input at 1,200 r.p.m.; the other at 19 g.p.m. with 5,000 psi. at 1,200 r.p.m.

The motor, which is claimed to be particularly suitable for use in plants where other types of power may present a fire hazard, as in explosives factories, is of the type employing a rotating cylinder carrying a large number of pistons which are actuated as the cylinder rotates within a cam-shaped track. Each of the 22 pistons is provided with a pair of rollers in contact with the three-lobed cam. The pump is provided with three intake and three discharge passages in the center stationary pintle so that each piston makes three power strokes per revolution, or a total of 66 strokes for the motor. By means of a speed control device which changes the angularity of the three-lobed reaction cam with respect to the pintle, infinitely variable speed control, both forward and reverse, can be secured. The motor may be driven by a hydraulic pump located outside the danger zone and connected to it by means of high pressure tubing.

COMBINATION FIRE ENGINE

Greater flexibility for the operations of industrial fire brigades is provided by a new combination fire extinguishing unit introduced by Cardox Corp., Bell Building, Chicago, Ill. Designed primarily to provide effective fire protection against a wide range of outdoor industrial fire hazards, the new unit has a capacity of 750 lb. of low pressure liquid carbon dioxide, and 32 gal. of mechanical foam solution. Two long-range carbon dioxide nozzles are provided, each with 100 ft. of ⅞ in. hose, the two having a combined discharge rate of 400 lb. of carbon dioxide per minute. A foam gun, provided with 100 ft. of ¾ in. hose line, has a discharge rate of 18 g.p.m., with pressure supplied by the carbon dioxide. The two extinguishing agents are intended to supplement one another. For example, in fires involving exposed flammable liquids, the carbon dioxide extinguishes rapidly, while the foam may be used for its blanketing effect to prevent re-ignition after extinguishment.

The unit is a compact four-wheel trailer, designed for exceptional stability even when hauled at high speeds. Three firemen, one for each hose line, ride on step plates at the sides and rear. The low pressure carbon dioxide liquid is stored in the trailer in a single, insulated, refrigerated pressure vessel at a controlled temperature of about 0 deg. F., and 300 lb. per sq. in pressure. Under these conditions a 47 percent yield of carbon dioxide "snow" is obtained on release. It is claimed this can be concentrated in one portion of the discharge and directed into the heart of the fire through relatively great distances, even in the presence of strong outdoor air currents.

MOTORIZED STACKER

Weight and cost approximately half those of standard high-lift platform and fork-lift trucks of similar load capacity are claimed for the new Transtacker battery-powered, high-lift, tiering units recently announced by Automatic Transportation Co., 149 West 87th St., Chicago 20, Ill. These devices are the motorized hand-truck counterparts of the usual fork-lift and high-lift platform trucks. They are available in four different models for all types of pallets and skid platforms and are capable of handling vertical tiering of unit loads in locations where floor or elevator capacities are limited and where extreme maneuverability is essential.

Like the company's Transporter, the unit is completely electric powered, with a motorized hydraulic lift, but is hand-guided. Its four models include the platform type, for skid loads, with a capacity of 4,000 lb.; a type for open-face pallets, with a capacity of 3,000 lb.; a straddle-type model for single- or double-faced pallets with a 4,000 lb. capacity; and a cantilever pallet type supporting pallet loads up to 2,500 lb. by counterweighing as in conventional fork trucks.

RAPID WEIGHER

Rapid repeat weighing in capacities from 0 to 500 mg., in the handling of powders, liquids and a variety of chemicals can be handled with an improved rapid precision balance announced by Roller-Smith, Bethlehem, Pa. The instrument can be provided with a variety of different pans for various purposes in production control, assaying and analytical work.

OPERATION RECORDER

An operation recording attachment that can be supplied as an auxiliary to instruments for recording and controlling pressure or temperature, in a variety of applications such as rubber curing, plastic molding, space heating, refrigerating and centrifugal drying, has been introduced by Brown Instrument Co., Philadelphia 44, Pa. The device makes use of what is known as a bimetallic warp switch and thus requires no solenoids or other fast operating devices which tend toward snap action and ink splashing. The construction is indicated in an accompanying illus-

Mammoth Conveyor Belt

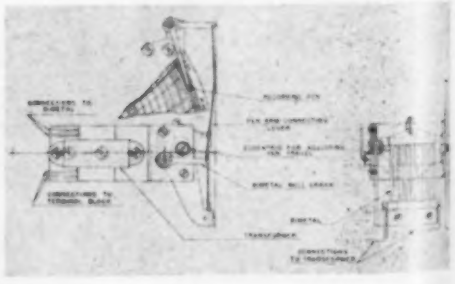
Some 72,000 lb. of belting is contained in this 25-ft. diameter roll, comprising one of the largest single conveyor belts ever built. Produced by the B. F. Goodrich Co. of Akron, Ohio, the belt is 5,100 ft. long, 48 in. wide and is of five-ply cord construction. The belt was produced in six lengths which, in order to prevent a major shut-down of the customer's conveyor system, were spliced together at the customer's plant. A special frame and wind-up were then built at the point of installation so that when the time came to change belts, the new one could be fastened to the end of the old, pulled over the pulleys and spliced endless on the job. After the photograph was taken, a shelter was built over the belt to protect it from the weather prior to its installation.

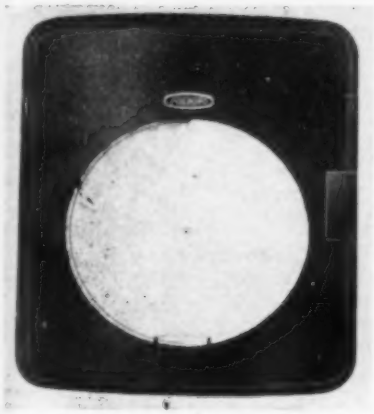
Combination fire engine

Rapid balance

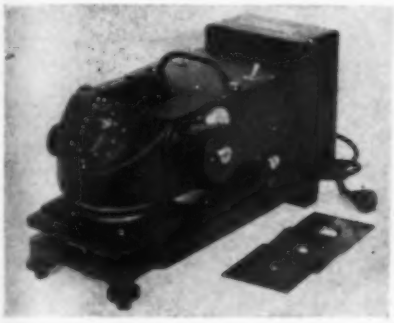
Platform type battery-powered stacker

Auxiliary operation recorder for temperature and pressure instruments





Improved Model 40 controller



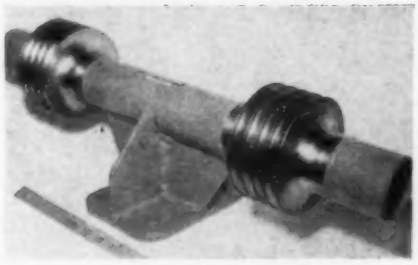
Air permeability meter

tration. The actuating element is a bimetallic strip through which a 1½ volt current passes whenever the power circuit of the pump, compressor or other piece of process equipment is energized. This causes heating and consequent warping of the bimetal, the movement being transferred mechanically to a pen which then moves about ⅞ in. in from the outer edge of the chart to give a continuous record of equipment operation. The device requires about 10 seconds after energizing to move the pen into proper recording position, and about 30 seconds after de-energizing to return the pen to the outer edge of the chart.

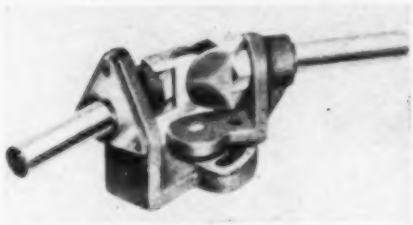
REDESIGNED CONTROLLER

Although it introduces no departure in basic operating principles compared with the earlier Model 30, the new Model 40 controller now being produced by the Foxboro Co., Foxboro, Mass., involves a complete redesign of the earlier instrument which was introduced in 1942. The instrument is applied to the control of temperature, pressure, flow and other variables in continuous processes.

The improvements may be generalized by describing them as a simplification of design, with sturdier unit construction, easier and more flexible adjustments, and greater convenience from a service standpoint. When the case door is opened, every dial and adjustment knob, as well as other parts normally requiring attention, is immediately accessible, without even removing the chart. This advantage is particularly important where service adjustments must be made in the field. The instrument is particularly adaptable for changing from one type of control to



Anchor type expansion joint



Angle motion transmitter

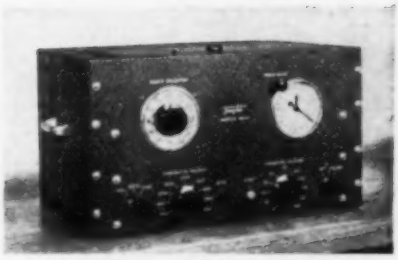
another, for example, changing the width of the proportional band, changing the reset range, reversing the instrument action, or eliminating the reset and derivative functions. Instant change can be made from manual to automatic control, or vice versa, without valve motion. The new instrument is made as an indicator as well as a single-pen and multi-pen recorder and is available for on-off control action, proportional, proportional and reset, proportional with derivative, and proportional with reset and derivative action.

LINK JOINT

An adjustable link mechanism that transmits rotary motion around corners, permitting the operation of shafts at angles adjustable from a straight line to 90 degrees, is being offered under the name of Universal Link Joint by the Piezo Mfg. Corp., 110 East 42nd St., New York 17, N. Y. This device, which is said to be especially adapted to the remote turning of valves and the remote operation of control equipment, safety equipment and signalling devices, may be operated by hand or with a low speed power drive. It is said to be free from backlash and to be preferable to bevel gears, racks and toggles for the purposes enumerated. Since the output shaft turns in exact angular rotation as the input shaft turns, exact reproduction of the input motion is obtained, an important factor in remote control. The device is produced in shaft sizes of ⅜ and ½ in., for working torques of 60 and 240 in.-lb.

PERMEABILITY TESTER

Designed for testing the air permeability of textile fabrics, very porous papers and other porous sheet materials, the new Gurley Permeometer, introduced by W. & L. E. Gurley, Troy, N. Y., has several novel features. One such feature is that the apparatus operates as a pneumatic bridge, with results not noticeably affected by motor speed variations or other variables. The system is thus analogous to a wheatstone bridge. A suction fan exhausts air from a reservoir. Voltage, speed and air-



Counter for radioactive impulses

flow variations have little effect on this suction, which is maintained by a gravity-actuated relief valve at 10 in. w.g. Air is drawn from the atmosphere through two parallel chambers into this reservoir. In the reference chamber a suction of 0.5 in. is maintained by standard inlet and outlet orifices. In the other, the test chamber, the suction is determined by the sample under test which is held in clamping rings. A calibrated flow metering valve, operated by turning a micrometer head, is adjusted until the suction in the test chamber balances that in the reference chamber, as indicated by a zero reading of an instrument connecting the two chambers. The valve reading is then a measure of the air permeability of the sample. The device will measure air permeability of materials which will pass from 1 to 400 cu. ft. of air per min. per sq. t., at a pressure drop of 0.5 in. w.g.

RADIOACTIVITY COUNTER

Known as the Autoscaler, a new instrument for quantitative measurements of radioactivity has been introduced by Tracerlab, Inc., 55 Oliver St., Boston, Mass. The instrument is line-operated and accomplishes the following functions: (1) It supplies the high potential for a Geiger-Mueller tube; (2) it counts the impulses from this tube; and (3) it measures the time required for reception of a given number of impulses. The instrument is automatic in operation without internal adjustment, is self-calibrating, and gives a fixed statistical error for each setting of the scale selector switch. Measurement of the time interval required for the accumulation of any selected number of impulses is accomplished by an output amplifier and cathode follower stage which actuates the clutch of the timer.

EXPANSION JOINT

Latest in the line of packless expansion joints produced by the MagniLastic Division of Cook Electric Co., 2700 North Southport Ave., Chicago 14, Ill., is the new Anchor Joint shown in an accompanying illustration. This device combines the rigid anchoring of the piping at accessible points, with allowance for unequal thermal expansion and contraction on either side of the anchor point. This is accomplished by varying the number of bellows flanges on either side of the anchor base to accommodate each condition encountered. The joints are made for standard pipe sizes from ½ to 24 in., for all pressures from vacuum to 1,000 psi. A variety of construction materials for corrosive and high temperature service permits temperatures to be handled in the range from —300 to 1,600

deg. F. A variety of standard fittings such as elbows, tees, etc., can be incorporated into these joints to make a single, compact and accessible unit. Welding ends are standard, with pipe flanges and inner linings optional.

AUTOMATIC DILATOMETER

CONTINUOUS recording of the thermal expansion and contraction of many materials including metals, glass, ceramics and plastics is the function of an improved automatic dilatometer developed by the Electronics Division of Sylvania Electric Products, Inc., 500 Fifth Ave., New York, N. Y. The device provides continuous graphic recording of a 12-hour expansion and contraction cycle of the sample. Supervision is necessary only for setting up the sample, recording being automatic during the balance of the 12-hour cycle. The instrument includes a furnace or sub-zero cooling chamber, a furnace thermocouple, a concentric quartz tube, a specimen thermocouple and the necessary mechanical and control equipment for providing specimen temperatures uniform within 1 deg. C. Automatic heating and cooling control are employed, with the specimen in an inert atmosphere.

SYNCHRONOUS MOTOR CONTROL

A NEW LINE of high-voltage combination starters for synchronous motors has been announced under the name of Hi-Fuse by Electric Machinery Mfg. Co., Minneapolis 13, Minn. These starters are said to be suitable for general installation in industrial plants with high voltage service, providing interruptng capacity generally adequate for all except the largest distribution systems. They provide disconnecting means, short-circuit protection and motor-overload protection and are furnished in voltage ratings up to 5,000 volts, with current interrupting capacity of 60,000 amp. asymmetrical. The control provides complete protection of motor and starter through coordination of functions of fuses and oil switch. Personnel is protected through segregated and interlocked high- and low-voltage compartments. The system used employs this company's polarized field frequency relay system of control which is said to cooperate with the synchronous motor to provide smooth and trouble-free starting.

HYDROCARBON ANALYZER

DEVELOPED initially by Westvaco Chlorine Products Corp., and brought out in commercial form by Industrial Instruments, Inc., 17 Pollock Ave., Jersey City, N. J., the Westvaco halogenated hydrocarbon analyzer is now available for continuous measurement of the concentration in the atmosphere of chemicals such as carbon tetrachloride, trichlorethylene, chloral and other halogenated hydrocarbons. The equipment is produced in both portable and permanent installation types and may be used in conjunction with a conductivity recorder.

In operation a constant stream of the sampled atmosphere is mixed with hydrogen in a fixed proportion and decomposed above 800 deg. C. in a quartz combustion tube. This produces the corresponding hydrogen halide which is continuously absorbed in a measured stream of distilled water, the electrical conductivity of which is then measured and recorded. Instruments operate on ordinary a.c. lighting circuits, consuming little current and less than 1 liter per hour of distilled water.

Automatic dilatometer

Starter for synchronous motors

Low-speed tachometer

Double-circuit pressure switch

LOW SPEED TACHOMETER

SPEEDS as low as 10 r.p.m. or 1 f.p.m. may be measured directly with the new Metron low-speed hand tachometer, Type 25B, which has three speed ranges of 10 to 200 r.p.m., 20 to 400 r.p.m., and 50 to 1,000 r.p.m. Similar in appearance to the standard instruments of this company's line which have ranges of ten times the above values, the new instrument is inherently sensitive to low speeds and does not use gears or other speed reducing adapters. Two units are employed, namely, the speed measuring head and the indicating unit. The tachometer head is not a generator but is a simple contact-making mechanism which alternately charges and discharges a condenser supplied with energy by means of a battery. The current flow through a milliameter is then proportional to the r.p.m. of the spindle. An accuracy of 1 percent of full scale is claimed. The same instrument may be equipped with adapters for either lower or higher speeds.

PRESSURE SWITCHES

THREE new pressure switches, operated by this companys' special bellows diaphragm, have been announced by the Cook Electric Co., Chicago 14, Ill. The ID type of industrial differential switch, illustrated herewith, may be used wherever two circuits need independent control at equal or different pressures. The bellows is of tinned phosphor bronze supported in a cadmium plated frame, applying pressure to two snap-action switches capable of carrying 10 amp. at 120 volts a.c. Either circuit of the device may be supplied to operate on pressures from 1 to 17 psi. However, similar switches can be supplied to operate at pressures up to 200 psi. Both circuits can be supplied normally open, normally closed, or either circuit normally open and the other closed. A typical application is where one switch operates as an on-off device for normal operation, leaving the other for alarm or cut-off.

The company's SD type switch is similar, however using only one snap-acting switch. The type LP low pressure switch employs a larger diameter bellows and can be supplied to operate at pressures from zero to 30 in. w.g., vacuum, or both.

REVERSE-ACTING DIAPHRAGM

FOR APPLICATIONS requiring a diaphragm control valve which is spring-closed and opened by the instrument air pressure, Fisher Governor Co., Marshalltown, Iowa, has introduced a new reverse-acting diaphragm motor top designated as Type 567. A novel feature incorporated in this design is that reverse action is secured without the use of a stuffing box in the top work. This is accomplished as follows: Instead of being attached to the stem at the center and moving with it, as is usual

the diaphragm is secured to the diaphragm casing both at its outer edge and at the center. Air pressure applied beneath the diaphragm lifts this annular portion, carrying with it a ring-shaped element attached to and moving the stem. This construction permits large diaphragm area, long stroke action, an inclosed spring separate from the pressure chamber, and a linear travel relationship to air pressure change. This diaphragm top is interchangeable with the company's direct acting Type P top.

SHEET PLASTICS FOLDER

FOLDING of thermoplastic sheeting ranging from 0.005 to 0.20 in. in thickness is accomplished by the new Thermofold plastic folding machine developed by the Plastics Equipment Division of Taber Instrument Corp., North Tonawanda, N. Y. The machine is employed in the fabrication of containers from rigid plastic sheeting, producing a U-type, 180 deg. fold with the sides tight together. An average operator can turn out 700 "formed folds" per hour through the use of the thermostatically controlled heat provided by the machine. Fold formation is actually molding of the material into the particular fold desired. The unit is hand fed and foot operated, with the actual fold cycle automatically controlled to assure trouble-free performance. Operation of the machine is relatively simple, consisting of six simple steps.

FLEXIBLE CONVEYOR

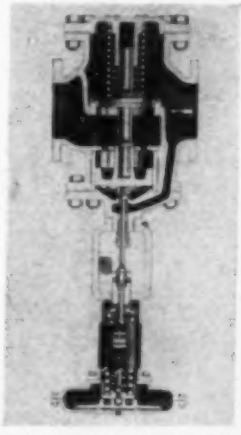
MULTIPLE endless steel springs, operating over 6-in. diameter grooved steel rollers spaced at 20-in. intervals, are used to form the conveying surface in the new electric-motor-driven Flexoveyor recently announced by E. C. Horne Machinery Co., 315 E & C Building, Denver 2, Colo. Suitable for handling packages and other units not heavier than 200 lb., the conveyor can carry around curves up to 90 deg. and will operate at a maximum inclination of 12 deg. Easy movement into or out of boxcars or to any point in the plant where the conveyor is needed is provided by supporting the equipment on swivel casters. The head and tail ends are adjustable in height while the unit is in operation. A standard machine has a length of 26 ft. 8 in. and a width of 20 in. Its capacity is approximately 1,500 bags per hour. Power is provided by a 1-hp. gearmotor with a reversing switch, applying power through a roller chain drive to the middle roll of the conveyor to permit movement in either direction.

BALANCED DIAPHRAGM VALVE

STEAM, air or gas pressures up to 1,000 psi. may be handled in a new line of single-seated, fully balanced diaphragm regulating valves announced by Leslie Co., 279 Grant Ave., Lyndhurst, N. J. Made with cast iron, bronze or steel bodies, these valves may be actuated by standard pressure or temperature instruments using 20 psi. air or clean water. Capacity is said to be equal to or greater than that of most double-seated regulating valves of the same size. An additional advantage is that the valve is tight in dead-end service, eliminating the leakage of fluid commonly experienced in most double-seated diaphragm regulating valves in the closed position. A new type reversing superstructure is available for this valve which permits it to be changed readily from normally closed to normally opened, without changing internal parts or removing the main body from the pipeline.

Folder for thermoplastic sheeting

Steel-spring flexible conveyor



Single-seated diaphragm valve

Rotating-pan mixer tilts for discharge

ROTATING-PAN MIXER

TO PERMIT such operations as mixing, blending, coating, coloring and polishing of drug and chemical products, the Ransome Machinery Co., 1421 South Ave., Dunellen, N. J., has introduced a new rotating-pan-type mixer which is motor-tilted and motor-rotated at constant speed. If necessary, variable speed drive can be provided. The pan is of all-metal construction with joints welded and ground smooth. Where the device is to be used for blending of two or more ingredients, mixing blades can be added as necessary. A tilting range of 135 deg. is provided, enabling materials to be completely and cleanly discharged from the rotating pan. Remote push-button control is provided for operation. Sizes range up to 50 cu.ft. (2,500 lb.) batch capacity.

ASBESTOS GLOVES

A SPECIALLY designed thumb arrangement with leather reinforcing completely covering the thumb at all points of hardest wear is available in a new line of asbestos gloves and mittens known as Guardwell that is being produced by Safety Clothing & Equipment Co., 7016 Euclid Ave., Cleveland 3, Ohio. The reinforcement is said to prevent the thumb seam from ripping open, greatly prolonging the life of this safety clothing. Reinforcements can also be secured for palm and thumb, or palm, fingers and thumb. All styles are available in any length.

EQUIPMENT BRIEFS

A NEW foot-operated valve for controlling the passage of compressed air to many kinds of air-operated cylinders has been introduced by National Pneumatic Co., Rahway, N. J. The valve can be adapted to supply pressure either with the pedal depressed, or with the pedal released. A shield is supplied to prevent accidental operation, and safety is further assured through return of the pedal by pressure of the air itself, thus preventing possibility of the pedal sticking in the downward position.

OF PARTICULAR interest to plants having an explosion hazard is the new compressed-air-powered vacuum cleaner announced by Management & Research, Inc., Oak Lane & Secane Ave., Primos, Pa. The cleaner has no moving parts and can be operated through connection to any 100 lb. air line. A small size is at present available, while a larger size is contemplated by the manufacturer.

ELIMINATION of seasoning defects and uncertainties in operating behavior are claimed for rollers made of thin, hard maple boards, laminated with waterproof adhesives, which are being supplied by Timber Engineering Co., 1319 18 St., N.W., Washington, D. C., as a substitute

for solid wood rollers. According to the manufacturer, the new laminated rollers can be produced in three weeks for a variety of applications, as compared with the four years required for properly seasoned solid rollers.

FIRE HOSE that is water repellent and mildew resistant is being produced for American-La France-Foamite Corp., Elmira, N. Y., by Goodyear Tire & Rubber Co. The new "All-Weather" line of hose is double-jacketed in white, the jackets being thoroughly impregnated by a process said to be the only one perfectly combining a water repellent and a mildew inhibitor in the same operation.

ONE OF the special elevating devices produced by Revolvator Co., North Bergen, N. J., is a combination elevating and unloading machine for barrels. The machine is countersunk so that the top of the lifting platform, is flush with the floor. Barrels are rolled on to this platform by hand, the operator throws a switch and the platform goes up. When the platform reaches the correct height for unloading it tilts automatically so that the barrel automatically rolls off on to the upper level, after which the platform immediately and automatically returns to the lowered position for another load. Automatic devices prevent the barrel from rolling off the platform on the way up.

FURTHER improvement in its Micro-Bean pulsation dampener for pressure gages has been announced by J. A. Campbell Co., 645 East Wardlow Road, Long Beach 7, Calif. This device, first announced several years ago, is said now to overcome the scoring problem claimed to be inevitable with all pulsation dampeners. The new device provides a screw which, when turned slightly, will bring back the seating to perfect control. It is only necessary to repeat this operation every two years or so to give the device a life, according to the manufacturer, of about 100 years. The device is available in sizes of ¼, ⅜ and ½ in., for pressures up to 6,000 lb.

A SEMI-AUTOMATIC molding press of 100 ton capacity, for either compression or transfer molding, has been announced by Watson-Stillman Co., Roselle, N. J. Degassing control by time, rather than limit switches is a feature which allows complete range of die opening and ready adjustability. Die space of the new press is 20x21 in. while the stroke is 12 in. and the operating pressure, 2,200 psi. A 5-hp. motor powers the unit.

TO PERMIT low-cost mass production of plastic or glass surfaces coated with metallic or low-reflection films, the National Research Corp., 100 Brookline Ave., Boston, Mass., has introduced an industrial high vacuum coating unit known as Model 3103 which employs a stainless steel cylindrical tank mounted horizontally, with a door at one end to facilitate loading. Inside dimensions limit the usable surface to 48 in. diameter by 48 in. long. Large quantities of small pieces can be coated, as well as large pieces. Vacuum is provided by two 10-in. diffusion pumps providing such an operating speed that three complete coating cycles per hour are claimed. Power supply for vaporizing the film material, together with all necessary instruments, are provided with the unit.

DEVELOPMENTS in portable pyrometers offered by Wheelco Instruments Co., 847 West Harrison St., Chicago, Ill., include a new extension type portable pyrometer and a portable pyrometer kit. The first unit permits the choice of plug-in angle extensions where a number of applications necessitate a universal instrument requiring the use of different kinds of thermocouple. The kit includes a straight-type extension with adapter for an iron-constantan surface thermocouple and an assortment of thermocouples. A carrying case is provided.

SMALL requirements for hot water around the plant and in laboratories can be handled, it is claimed, by one of the new small-capacity automatic electric water heaters being offered by Modo Home Products, Inc., Bourbon, Ind. Made of stainless steel, these units are available in capacities of 3, 5, and 7½ gal.

STAINLESS STEEL FITTINGS

WHAT is said to be one of the most complete lines of stainless steel welding fittings available postwar is that now being manufactured by Tube Turns, (Inc.), Louisville, Ky. These fittings, now supplied through local distributors in principal cities, include 180-deg. long radius returns, 90-deg. long radius elbows, 45-deg. long radius elbows, straight tees, reducing outlet tees, caps, eccentric reducers, concentric reducers, and many other types, in sizes ranging from ⅜ to 12 in. Three grades of stainless, including 304, 347 and 316, are available, estimated by this company's investigators to meet 95 percent of industry's standard requirements.

PRE-WELD TESTER

SUCCESSFUL use of the Sperry Supersonic Reflectoscope in the studying of plates prior to welding has been announced by the Babcock & Wilcox Co., Barberton, Ohio. Difficulties are sometimes encountered in the welding of plates owing to the concentration of segregations and inclusions along the welding edge. The company has been studying non-destructive means for examining plates along their edges prior to welding, thus making possible the selection of those plates which will weld satisfactorily. The new instrument sends supersonic vibrations through the plate, and by measuring the length of time for these vibrations to penetrate the material, reflect from the opposite side and return to the starting point, detects flaws in the plate and also locates the defects. Weaknesses in plates such as are detected by this method would be found in an X-ray examination of the completed vessel, but the company desired to avoid the difficulties which would result by pre-selecting suitable plates. A variety of other methods tested failed to give suitable results. Work with the Reflectoscope is by no means completed, it was indicated, but results are hopeful and indicate so far that plates 1½ in. thick and over may easily be classified, although thinner plates require more study.

Hermetic-sealed time indicator

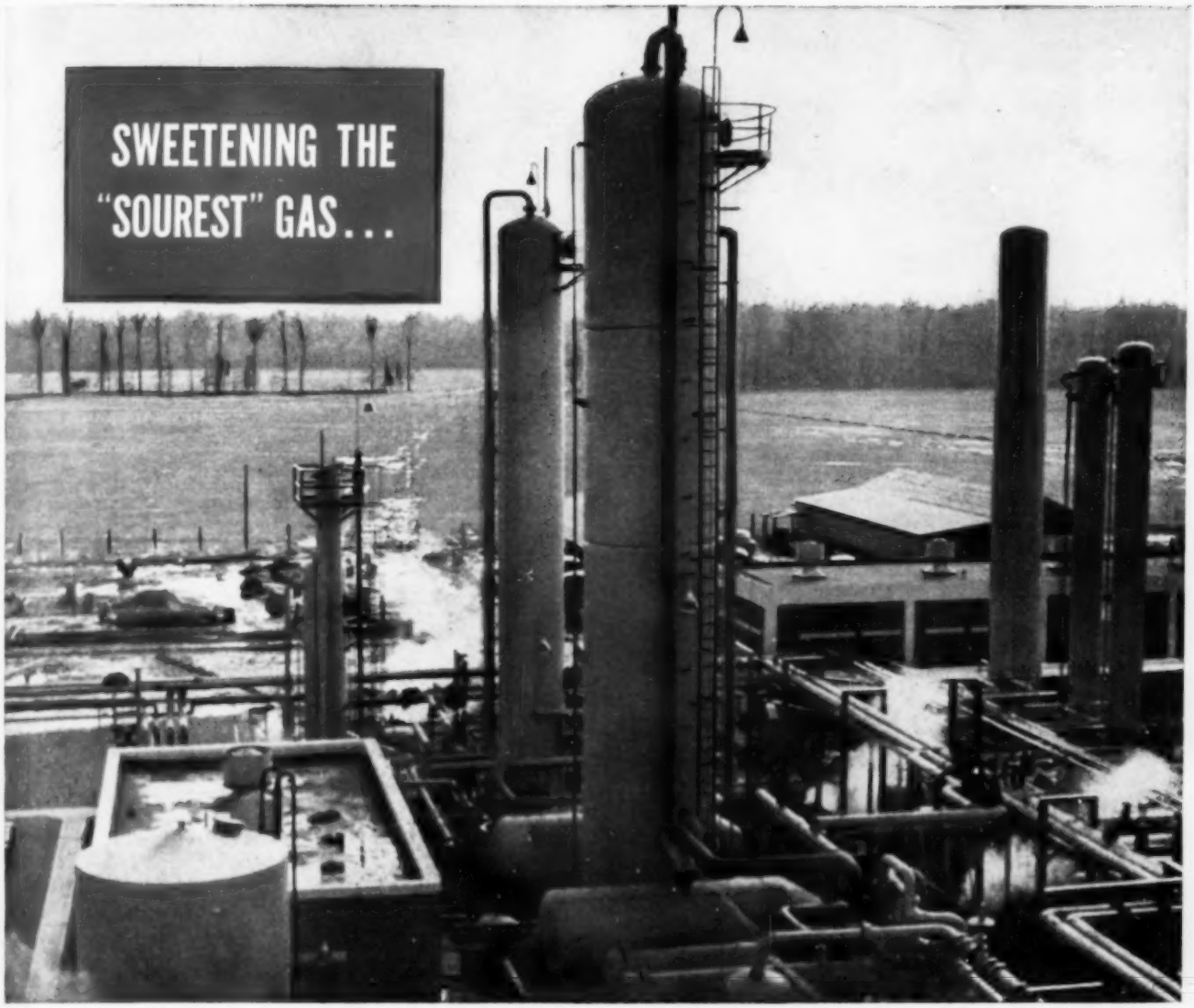
ELAPSED TIME INDICATOR

ELAPSED TIME up to 10,000 hours can be measured with the new model HM3 elapsed time indicator offered by Marion Electrical Instrument Co., Manchester, N. H. The indicator operates on 115-volt, 60-cycle current and features a glass-to-metal hermetic seal construction which is said to make it particularly suitable for use in industries where corrosive atmospheres or high humidity would attack a conventional instrument.

DIAPHRAGM CONTROL VALVE

COMPLETE redesign is featured in the new line of Kontrol Motor diaphragm valves for pressure regulators, pump governors and diaphragm motor control valves, offered by Kieley & Mueller, Inc., North Bergen, N. J. All-steel construction is employed for strength and light weight, the diaphragm casing being boltless and assembled with quick-acting clamp rings. The diaphragms are molded of reinforced neoprene and are said to provide an unusually large effective area. Heavy, fully inclosed, heat-treated springs are used to provide maximum power. All valves are provided with position indicators. Bodies, produced in bronze, semi-steel, cast steel and special alloys, with a variety of trim materials, have been designed for unrestricted flow and high capacity. Disks are guided both top and bottom and are available in quick opening, percentage and parabolic types.

Diaphragm motor valve



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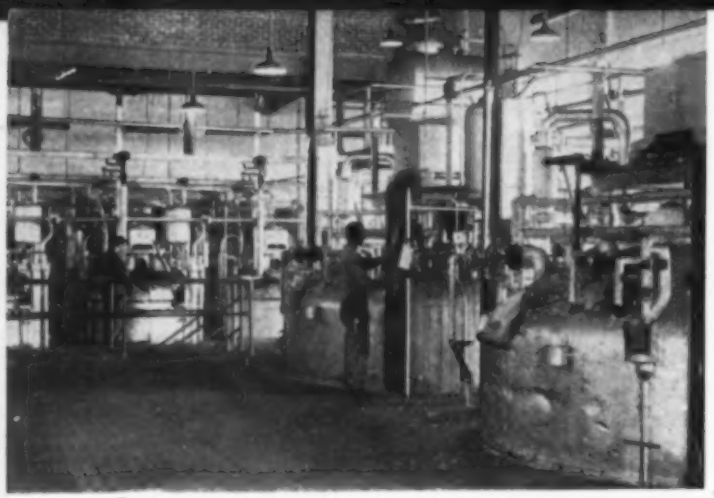
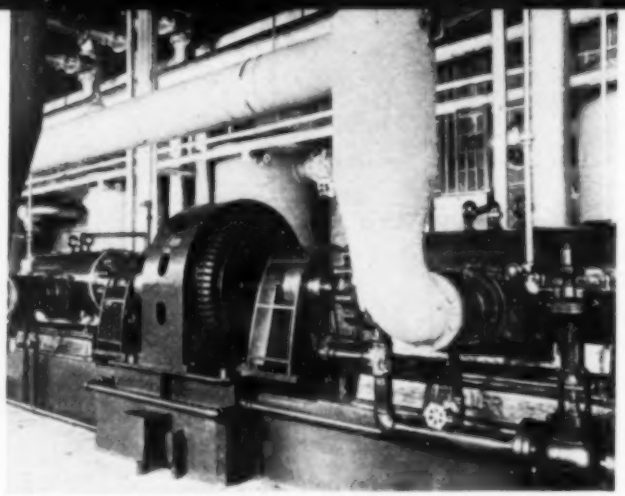


2 Process variables are automatically controlled in these agitated fermenters made of carbon steel



3 Rotary compressors supply sterile air to the fermenters; aeration is the key to submerged fermentation

STREPTOMYCIN

FIRST full scale production of streptomycin was achieved by Merck & Co., in its plants at Elkton, Va., and Rahway, N. J.

Sterilized mash is inoculated with a pure culture of *Streptomyces griseus* and aerated under aseptic conditions at 25 to 30 deg. C. Four sizes of vessels in series are employed in a system of mass inoculation. After several days optimum growth is reached.

Fermented broth flows continuously through a pressure filter to remove mycelium. Filtrate pH is carefully adjusted before passing through a second filter. Cake from both filters is discarded. Activated carbon is automatically proportioned to the clear broth where it adsorbs the streptomycin. Carbon slurry is filtered, washed with alcohol and refiltered to remove soluble impurities. Streptomycin is recovered from the carbon adsorbate in a two stage countercurrent elution process using acidified solvent. Impurities remain on the carbon. Neutralized eluate is concentrated and dehydrated in a series of single pass evaporators operating under vacuum and at relatively low temperature. Crude streptomycin in the concentrate is then precipitated and filtrated. It is dried and redissolved before passing to a process where complex reactions remove toxic impurities. Purified streptomycin is precipitated, filtered and dried, then redissolved and filtered through a biological filter. In special stainless steel containers, purified concentrate is shipped to Rahway for finishing.

Concentrate from the shipping containers is first blended and passed through a biological filter which removes pyrogens. This is metered into stainless steel trays and frozen at —40 deg. C. Frozen concentrate is then placed in a high vacuum dryer where sublimation takes place, leaving a pure dry cake. Ball mills reduce the dry cake to a fine powder which is weighed into sterile vials. For a more detailed description of the process turn to pages 94-98.

CHEMICAL ENGINEERING

October, 1946

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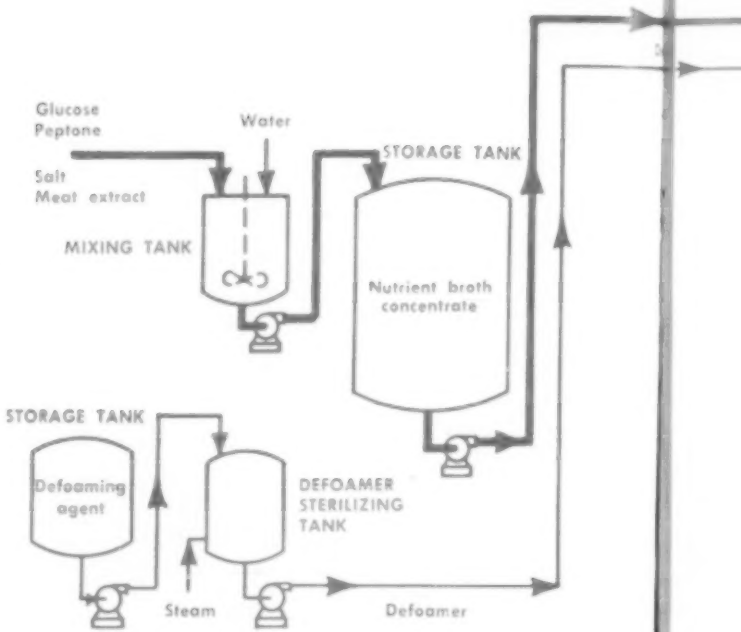
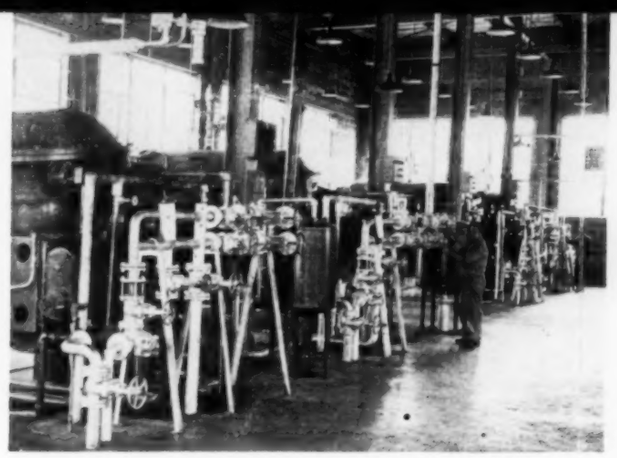
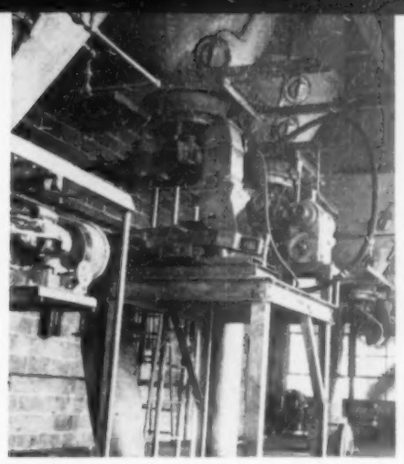


1 Plant production starts by inoculating small fermenters with a sterile culture of *S. griseus*

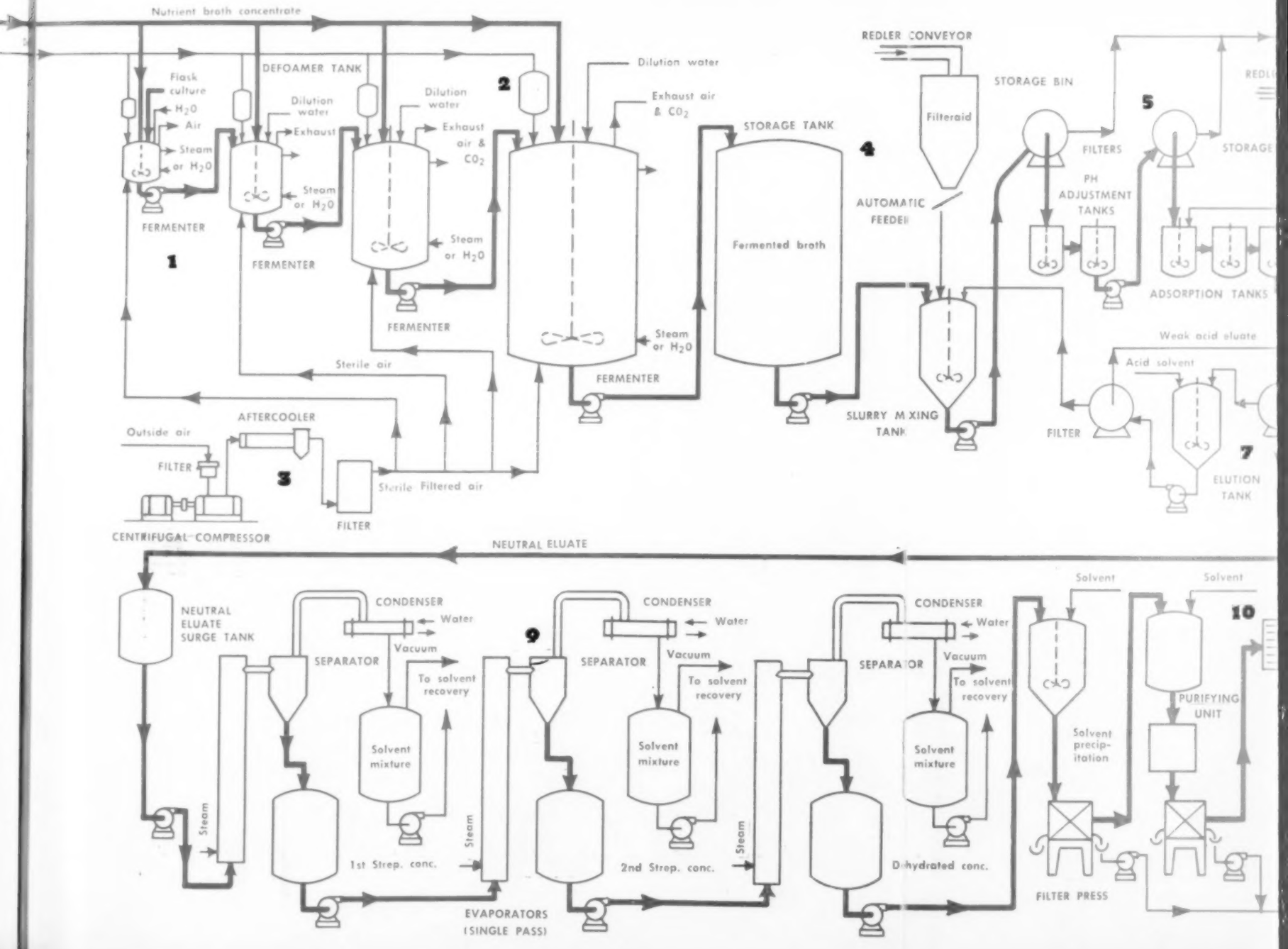
4 Fermented broth from storage tanks supply the continuous recovery process

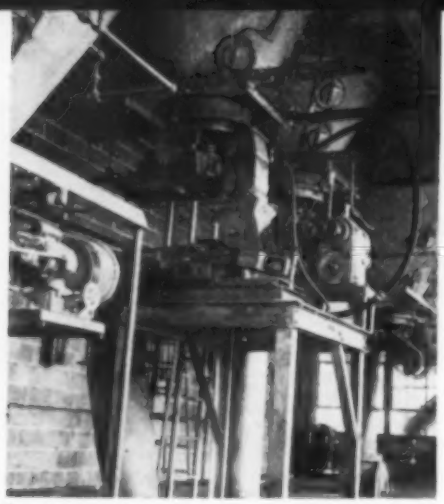


5 First step in the recovery process is removal of mycelium from the broth in continuous pressure filters

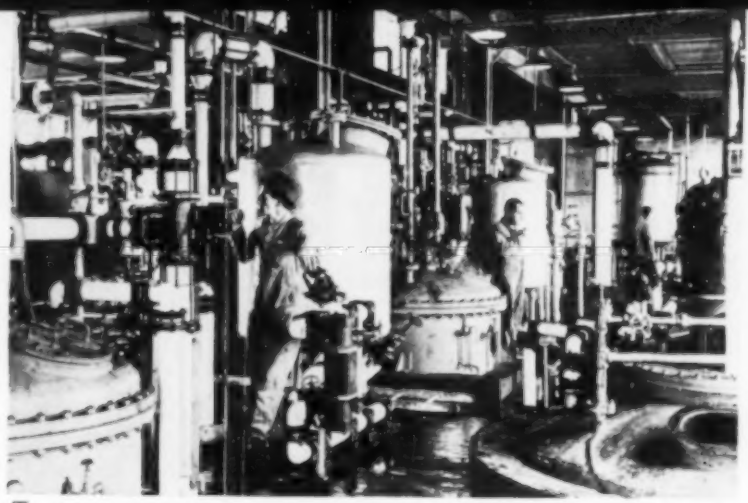


6 Automatic feeders proportion activated carbon to the adsorption process



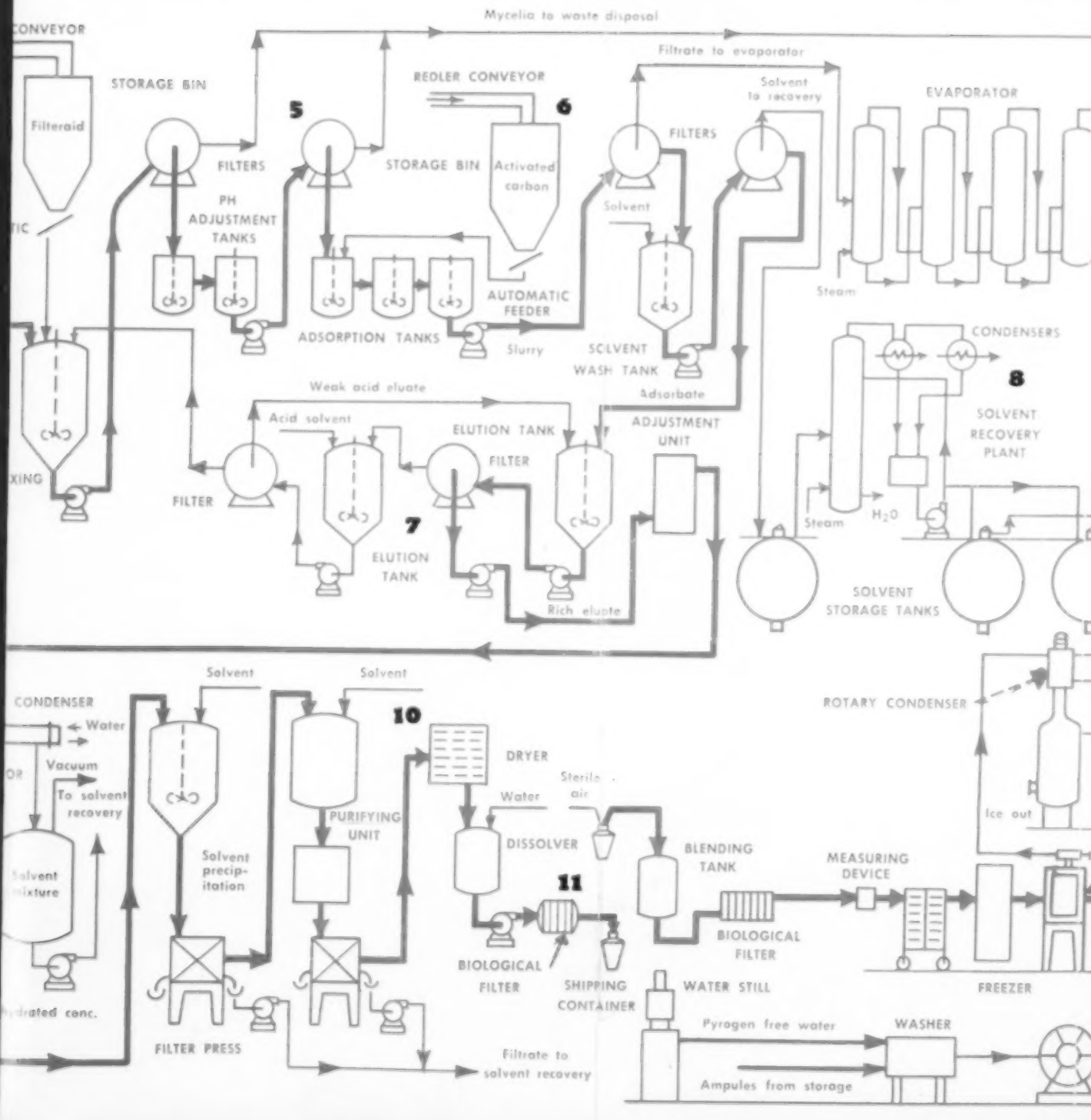


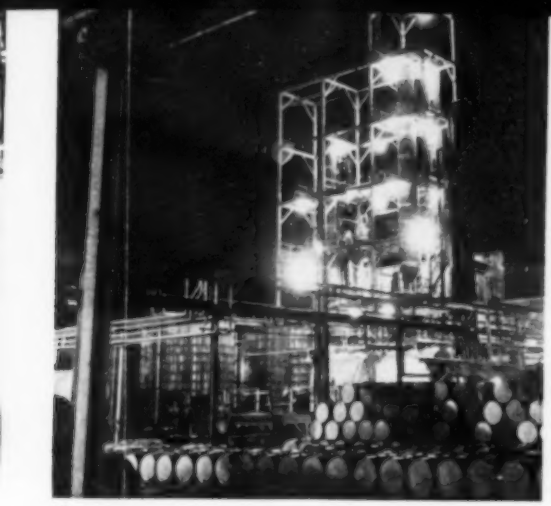
6 Automatic feeders proportion activated carbon to the adsorption process



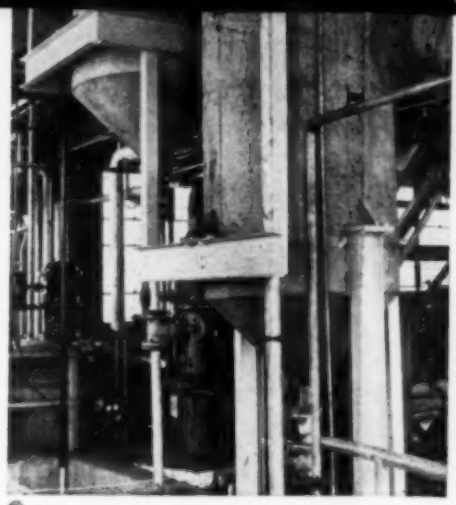
7 Rubber lined tanks, porcelain pipe, with pumps and filters of resistant alloys prevent corrosion during elution process

8 Dis... solven...



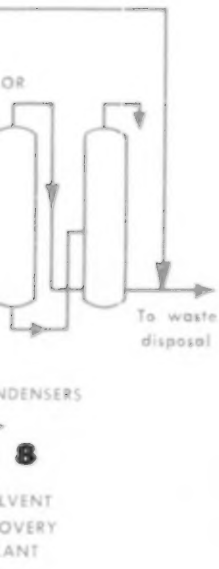


8 Distillation towers in this unit recover all solvents used in the streptomycin extraction



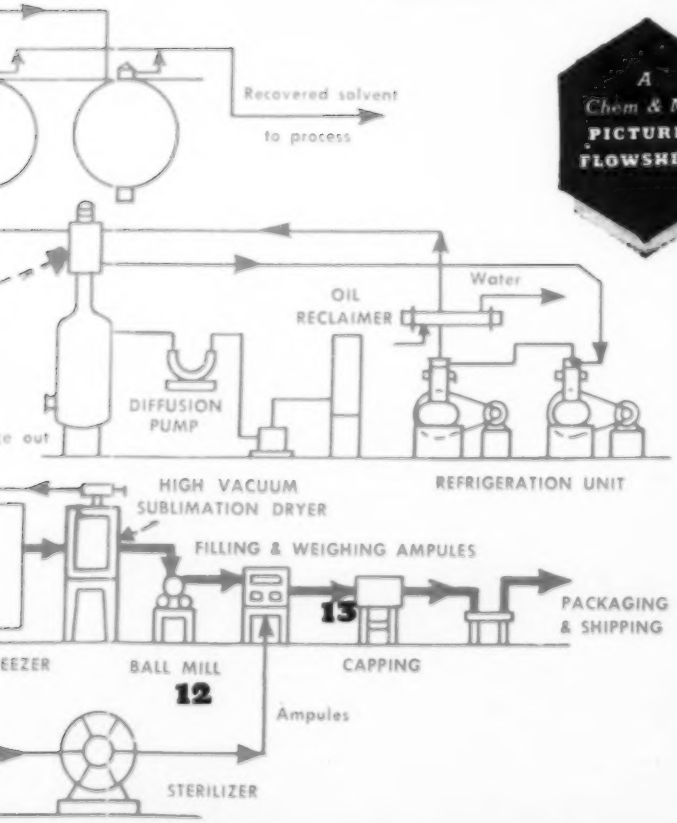
9 Separators prevent any entrainment losses of liquor from the evaporators

10 Reactions in these vessels eliminate impurities



11 Special filter disks remove pyrogens from purified concentrate

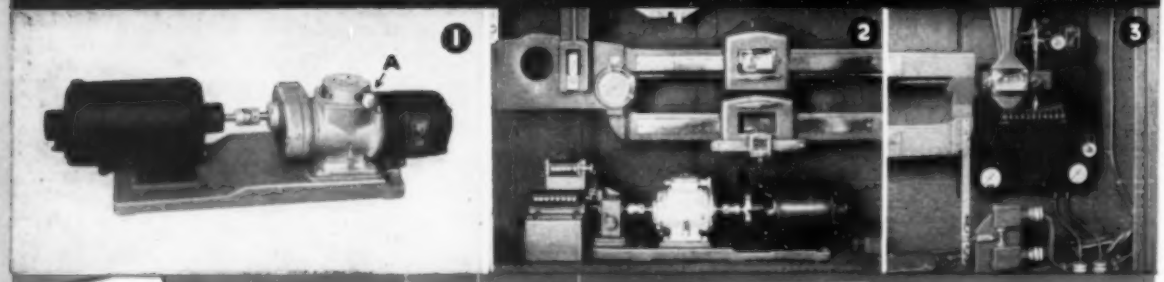
12 Dried cake from high vacuum sublimation is powdered in mills employing sterile steel balls



13 In sealed cubicles, safeguarded with ultraviolet light, streptomycin powder is weighed into vials

Greater Accuracy-Closer Control

WITH %PROPORTIONEERS% "LOSS-IN-WEIGHT" SYSTEM



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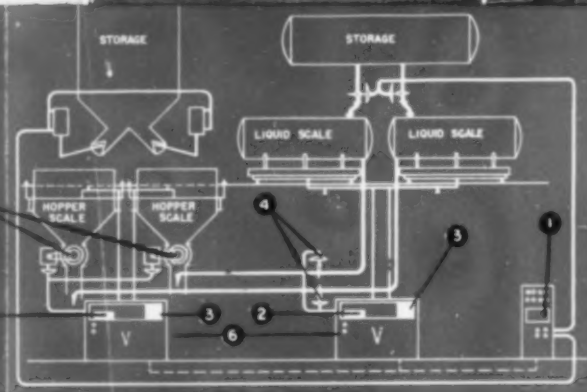
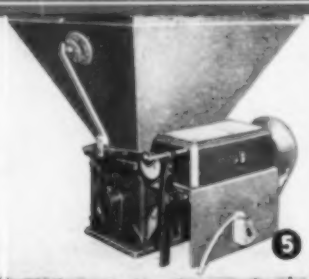
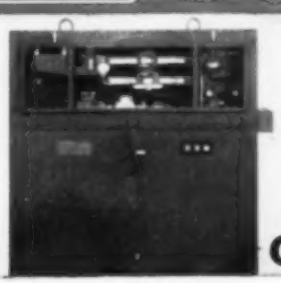


Schematic flow diagram for blending dry and liquid ingredients.

Variable Speed Master Control Unit (1) regulates individual rate of component feeds through Secondary Synchronized Variable Speed Drives (2) which operate Loss-in-Weight Scales (6). Total blend rate and individual feeds are regulated at dials (A) and (B) (with verniers graduated to 1 part in 400). Any departure from rates set is automatically corrected by Control Units (3) which position either Fluid Control Valves (4) or regulate speed of Rotary Feeding Heads (5) on dry materials.





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%Proportioneers% "Loss-in-Weight" System is the modern, completely flexible method for continuous compounding. It automatically maintains pre-set component ratios or permits infinite adjustments in formula or total rate without interrupting the process. This and other new %Proportioneers% continuous production methods anticipate tomorrow's requirements in the fast-moving process industries. Look to %Proportioneers, Inc.% for up-to-the-minute engineering advice and the latest proportioning equipment — flow responsive or constant rate.

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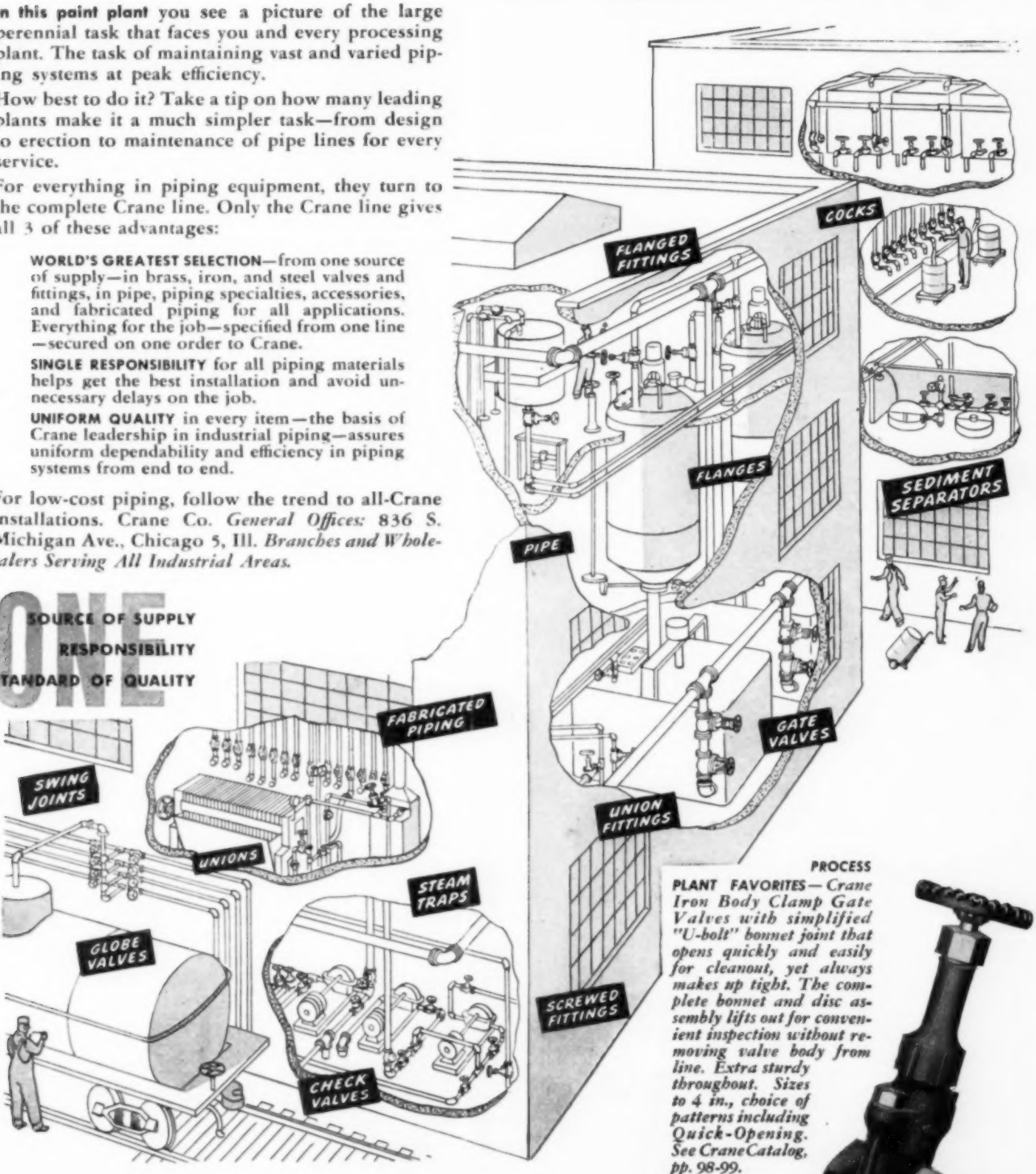

PROCESS PLANT FAVORITES—*Crane Iron Body Clamp Gate Valves with simplified "U-bolt" bonnet joint that opens quickly and easily for cleanout, yet always makes up tight. The complete bonnet and disc assembly lifts out for convenient inspection without removing valve body from line. Extra sturdy throughout. Sizes to 4 in., choice of patterns including Quick-Opening. See Crane Catalog, pp. 98-99.*

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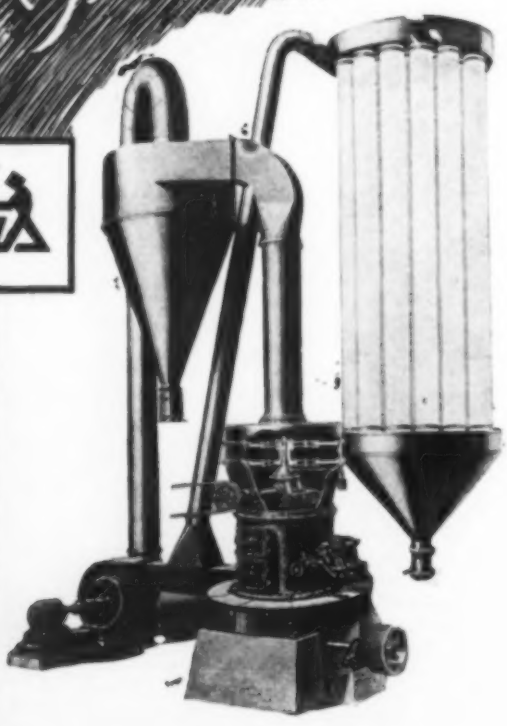
FOR EVERY PIPING SYSTEM

RAYMOND Whizzer type ROLLER MILL



THE revolving *whizzer separator* is one of the main features that is making the Raymond Roller Mill so increasingly popular in the chemical and process industries.

This important unit is furnished either in the *single* or *double* whizzer, according to the nature of the material to be pulverized or the fineness of grind.

The revolving whizzer blades are operated independent of the mill through an individual motor drive with variable speed transmission. Changing the speed of the whizzer provides a wide range of classification from 60% minus 100 mesh up to 99.9% passing 325-mesh.

This flexible fineness control is a special advantage in custom grinding, where different grades of products are ground in the same mill. The whizzer separator not only gives closer product control, but also results in higher capacities and more uniform finished materials.

Whizzer-equipped Roller Mills are economically adapted for handling such products as chemicals, pigments, barytes, bentonite, bauxite, kaolin, magnesium oxide, phosphate rock and talc.

Whizzer Separators may be built integral with new Raymond Roller Mills, Imp Mills and Automatic Pulverizers . . . or furnished as a motor driven unit for attaching to your present Raymond Mill. Write for further details.

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COMBUSTION ENGINEERING COMPANY, INC.
1311 North Branch Street Chicago 22, Illinois

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Fineness instantly adjustable while running

NEW PRODUCTS AND MATERIALS

R. W. PORTER, Assistant Editor

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PETROLEUM SOLVENTS

Now in commercial production by the Shell Chemical Corp., 100 Bush St., San Francisco, Calif., a group of new non-corrosive solvents known as sulfolanes, were developed during the war. They are used in the petroleum industry to remove sulphur and to separate various petroleum components and it is predicted that their non-corrosive nature will increase the life of valuable refinery equipment. Compared with many other commercially employed solvents, the sulfolanes have the advantage of chemical inertness. They do not decompose in the presence of traces of acids and alkalis, or with sulphur. In addition they can be removed from any mixtures by a simple water wash. Sulfolanes are being investigated for other applications such as the refining of vegetable oils.

PAINT BRUSH CLEANER

Developed to increase the life of paint brushes during the shortage of bristles, the Devoe and Raynolds Co., Inc., 44th St., and First Ave., New York 17, N. Y. have announced a new postwar product under the brand name of Devoe brush shampoo. This is claimed to be equally efficient for cleaning hardened paint, lacquer, varnish, shellac or enamel. It is claimed to clean the brush right down to the heel and is non-injurious to hog bristle, nylon, or setting compound. It is easy to use, has a pleasant odor, and does not injure the painter's hands. This brush cleaner is a concentrated material and is used after reducing it with an equal part of water. It is available in pint size packages.

WATER RESISTANT LABEL GLUE

Made possible by the return of prewar raw materials, a new, improved water and ice-proof bottle label machine glue is now being manufactured by Paisley Products, Inc., 1770 South Canalport Ave., Chicago 16, Ill. Under the brand name of Cooler-Proof, this material is a jelly glue reddish brown in color and odorless. It is supplied in the proper body, making it ready to use. The jelly character of the glue is claimed to provide a tough, flexible, non-crystallizing glue film that withstands considerable water immersion has resistance to damp atmosphere of refrigerators and ice boxes. Its resistance to water enables its use on wet bottles, avoiding dilution of the adhesive when applied which, oftentimes with ordinary glues, causes labels to loosen after passing through the machine. It is applied in a thin film to obtain maximum tackiness to hold paper labels in place on the glass. One filling of the glue pot is said to serve the average label machine for a full 8-hr. shift. Returned bottles are easily cleaned of labels and glue through regular washers and soaker equipment without resorting to special cleaning compounds. Cooler-Proof glue is available in 55- and 30-gal. drums, and 5- and 1-gal. containers.

HEAT RESISTANT PLASTIC

Possessing heat resistance and the ability to be machined to close tolerances, a new plastic which is particularly well adapted as an insulator in electrical connectors and other components of high frequency products, has been announced by the General Electric Co., Pittsfield, Mass. Under the brand name of Textolite 1422, the new material possesses a low power factor with an ASTM heat distortion of 105 to 113 deg. C. It machines readily enough to be adaptable to automatic and semi-automatic fabricating equipment. It is claimed that this new plastic can be used in many fields where compression and injection-molded plastics are not sufficiently suitable because of the close tolerances, or where they do not possess the necessary combination of heat-resistance and electrical properties. Tests disclose that under normal loads it will maintain its shape up to 200 deg. C. It is suitable for use in coaxial cables. It is claimed to be a good material for structural components in high frequency equipment where low power factor is required and where operating temperatures prevent the use of polystyrene. It has a good dielectric constant and power factor which, in addition to its heat resistance, make it applicable to connector beads, ultra high frequency antenna and oscillator coils.

Physical properties of Textolite 1422 make it useful for various applications where the finished product must be able to withstand considerable strains and abuse under severe service conditions. It has a specific gravity of 1.045 to 1.050; tensile strength of 8,000 to 10,000 lb. per sq. in.; flexural strength (ASTM-D638-42T) of 15,000 to 18,000 lb. per sq. in.; compression strength (ASTM-D649-42T) of 18,500 to 19,000 lb. per sq. in.; impact strength, (ASTM-D256-43T) of 0.25 to 0.35 and a Rockwell hardness-scale, of 68 to 72. Water absorption (ASTM-D570-42) is less than 0.05. The material is unaffected by mineral acids, alkalis, alcohols, aliphatic hydrocarbons or mineral oil. Aromatic hydrocarbons cause swelling while chlorinated hydrocarbons and ketones cause only slight swelling.

AQUEOUS GLYOXAL

Limited quantities of glyoxal-30 percent, an aqueous solution of the simplest dialdehyde, have been available for some time. However, this material will soon be produced on a commercial scale by the Carbide & Carbon Chemicals Corp., 30 East 42nd St., New York, at its West Virginia plant. When commercial quantities become available in tank car and drum car load quantities, new lower prices for glyoxal-30 percent will be announced. The tank car price will be 17c. per lb. f.o.b., South Charleston, W. Va. Having the formula $(CH)_2O_2$, and also known as ethanedial, glyoxal has two functional groups which permit many reactions not possible with monoaldehydes. It can be easily oxidized to formic acid and may also be converted to glyoxylic acid. When mixed with dilute alkali, glyoxal undergoes a Canizzaro type reaction to form salts and gylcolic acid. It will reduce mildly alkaline solutions of silver salts, precipitating the metal. Acetals are formed in the usual manner with compounds containing alcohol groups, and condensation will occur between glyoxals and compounds possessing reactive hydrogen atoms, such as organic amines, ammonia, hydrocyanic acid, and hydroxylamine. Glyoxal can serve as a modifying agent for compounds which contain the polyhydroxl group, such as polyvinyl alcohol and carbohydrates. It has been suggested for use in the hardening and insolubilization of casein sizes used in papermaking. Advantages include higher wet tensile strength and a lower concentration of aldehyde due to low volatility of aqueous glyoxal as compared to formaldehyde. Glyoxal reacts with aliphatic amines to form products of interest to the pe-

troleum industry as detergents, stabilizers and other oil additives. Glyoxal in the pure state is a greenish-yellow watersoluble liquid which readily polymerizes to a white solid. In aqueous solutions glyoxal exists as a mixture of a series of non-volatile, hydrated forms. These forms of hydrated glyoxal appear to be in equilibrium with one another, and in most cases undergo the reactions expected of the unhydrated aldehydes. The commercial glyoxal solution contains small amounts of glycol, glycolic acid, formic acid and formaldehyde.

Properties and Specifications of Glyoxal

Specifications — Aqueous Solution	
Glyoxal content, percent by weight	Approx. 30
Sp. gr. at 20/20 C	1.24 to 1.28
Color	Light-yellow
Average weight per gal. at 20 deg. C., lb.	10
Physical Properties — Pure Glyoxal	
Mol. wt.	58.02
B. pt. at 760 mm. deg. C.	50.4
M. pt., deg. C.	15
Sp. gr. at 20/4 deg. C.	0.14
Solubility in water	Complete

HUMIDITY INDICATOR

RECENTLY announced by Eljay Enterprises, Box 891, Newark 1, N. J., is an ink which when applied to paper indicates the degree of moisture in rooms, containers and other similar places by changing color. Under the brand name of Hygro-Ink, this material may be painted, sprayed or printed on paper, cloth, metal or similar surfaces. It dries in a few minutes at temperatures of 110 to 150 deg. F. and will dry at room temperature in an hour or so if the relative humidity is below 50 percent. After drying it is humidity-sensitive; that is, it turns from blue-green to pink as the humidity changes from high to low humidity. The color change is distinct, definite and reversible, being a brilliant blue-green when dry, and pink when moisture, dampness or humidity reaches the point where mold, mildew, corrosion, rust, and warping take place. It has been used to determine the amount of moisture in powder, cereals, cotton, cloth, paper, tobacco and other similar materials, and it has been used to check leakproofness of glass, cellophane, wax, or other sealed packages.

LUBRICATING OIL

DESIGNED to prevent the formation of engine deposits of sludge and varnish, a new lubricating oil to be marketed under the brand name of Havoline has recently been announced by the Texas Co., 135 East 42nd St., New York, N. Y. It is made from carefully and specially refined paraffin base crude plus metallo-organic active compounds soluble in the oil. It is claimed to prevent oxidation and the formation of corrosive acids. It is clean burning, heat resistant, and clings to the bearings under all operating temperatures and pressures. This oil is claimed to maintain maximum seal between cylinders, walls and pistons, permitting maximum engine performance. It has been thoroughly tested in various parts of the country in actual service, but in extensive laboratory tests it is claimed to have reduced deposit formation to less than one-tenth of that observed with prewar types of motor oils. Piston ring wear is claimed to have been reduced by more than 20 percent.

CHEMICAL EXPLOSIVES

FIRST COMMERCIAL use of RDX, the war's most powerful chemical explosive, has been made by the Western Cartridge Co., East Alton, Ill. Also known as cyclonite, the manufacture of this material was one of the most closely guarded secrets early in the war. It was a component of the super blockbusters used in European operations. Because of its great power, it is now used to make the smallest blasting caps ever developed. It is claimed to have 50 percent more power than TNT. RDX has a rate of detonation making it ideal for this new product. The length of the new blasting cap is hardly more than 1¼ in. long and less than ¼ in. in diameter. It is made of aluminum and is safer to handle than the ordinary blasting caps. It can withstand the shock of a fairly heavy impact without detonating.

First developed in Germany in the 1920's it was brought to this country and produced in a government arsenal. Not until the recent war was it manufactured on a large scale.

Cornfields are sprayed at the rate of 30 acres per hour with Syndeet, an insecticide containing DDT, available from the U. S. Rubber Co., Akron, Ohio

BRASS CLEANING AGENT

ANNOUNCED recently by Enthone, Inc., 442 Elm St., New Haven, Conn., is a new alkali cleaner for metals. Known as Enthone Brass Cleaner, this material is said to have high detergent ability in combination with no tarnishing action on active metals, including copper, brass, bronze, nickel, silver, tin and lead. It can be used as a general plating room cleaner for cleaning of steel and the metals listed above. It may be used for soak cleaning, maintaining its detergent action over long periods. Special alkalis are blended with the surface active materials to inhibit attack, clean in hard water, and rinse freely. It is buffered to give a pH between 11 and 12. A concentration of about 6 oz. per gal. of water temperature of between 180 and 210 deg. F. is optimum for either soak or electrolytic cleaning.

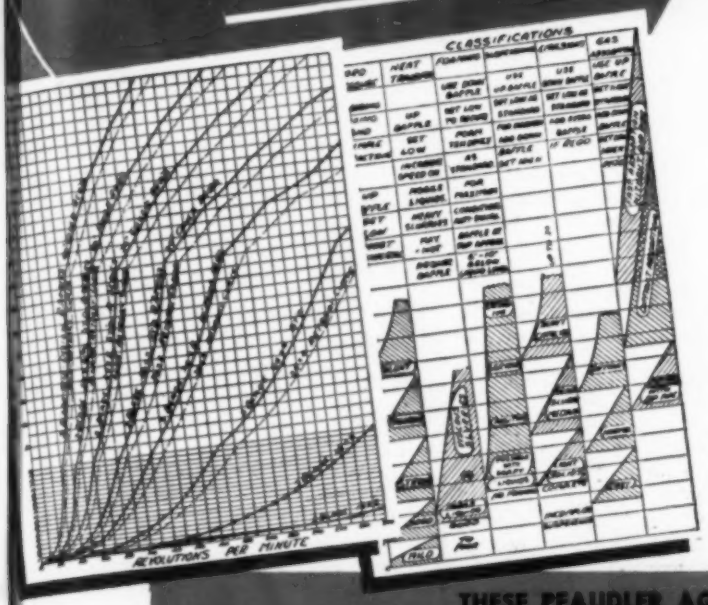
HEAT RESISTANT THERMOPLASTIC

DEVELOPED by the Mathieson Alkali Works, polydichlorostyrene is claimed to have high heat-resistance and outstanding electrical properties. It may be molded by injection, and shows no loss of hardness, strength, or change in shape after boiling. It is claimed to absorb less water than any other thermoplastic. It is expected to find application as parts of electrical and industrial equipment where chemical and hot water resistance are of importance. It may also be used in the manufacture of medical and surgical instruments that require frequent sterilization.

PLASTIC COMPOUNDS

TWO NEW commercial plastics have recently been announced by the West Coast Plastics Enterprises, 4891 Huntington Drive, Los Angeles 32, Calif. The first of these is a commercial phenol formaldehyde condensation product designated as Ivoricast which is said to differ from other casting resins of its type in that it makes use of a plasticizer instead of a filler to obtain its normal chemical and physical properties. However, when fillers are added to the basic compound it will develop certain characteristics claimed to be unique in phenolic plastics. Experiments have shown that an asbestos filler will enable Ivoricast objects to resist an open flame-charring only at temperatures of more than 400 deg. F. Wood-flour filler makes it possible for objects of this plastic to

THE Pfaudler AGITATIVE SYSTEM KEEPS YOU FROM GOING IN CIRCLES



Over a period of many years, Pfaudler engineers have formalized a procedure for determining the right type of agitation required for a given job. This is based on a simple linear relation between batch size and "agitative possibility," called "agitative intensity." Agitative intensity is the agitative possibility per unit volume.

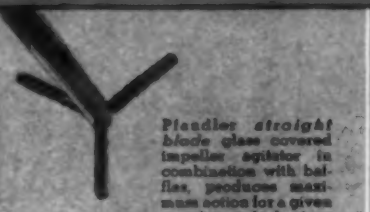
Its application has been checked against numerous actual industrial mixing problems and found workable. Consequently, a table of intensity ranges has been established for each type of application. While it does not eliminate the factor of judgement, it is a guide to the proper relationship between agitator design, size and speed for given jobs.

Intensity levels are modified in accordance with viscosity, relative depth of the liquid, baffling, the required reaction rate, foaming tendencies and other properties. A full description of "The Pfaudler Agitative System" with charts showing how to figure mixing requirements, is yours for the asking. Use the coupon below.

GUIDES TO PROPER SELECTION
Left: This chart aids you in predetermining correct agitator design.
Right: Classification chart with corresponding agitative intensities . . . both available on request.

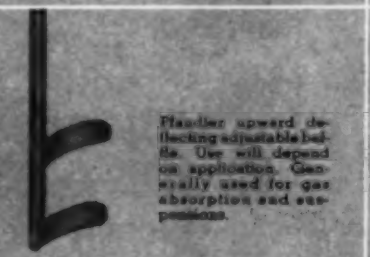
AN ECONOMICAL SOLUTION FOR . . .
- Reactions
- Emulsions
- Gas absorption
- Blending
- Suspension of solids

THESE PFAUDLER AGITATORS IN COMBINATION WITH ADJUSTABLE BAFFLES (PATENTED) HANDLE ALMOST ANY LIQUID MIXING PROBLEM!



Pfaudler *straight blade* glass covered impeller agitator in combination with baffles, produces maximum action for a given speed—works best on light products.

Pfaudler *retreating blade* glass covered impeller tends to produce "roll over" of batch even without baffle. Efficient on viscous products—keeps power requirements low.



Pfaudler upward deflecting adjustable baffle. Use will depend on application. Generally used for gas absorption and suspensions.

Pfaudler downward deflecting baffle. Use depends on mixing desired. Generally good for products that foam and for emulsions.

Standard Pfaudler "K" Series glass-lined reactor equipped with glass covered straight blade impeller with baffle. Latter can be moved up or down to yield varying degrees of turbulence.

Pfaudler

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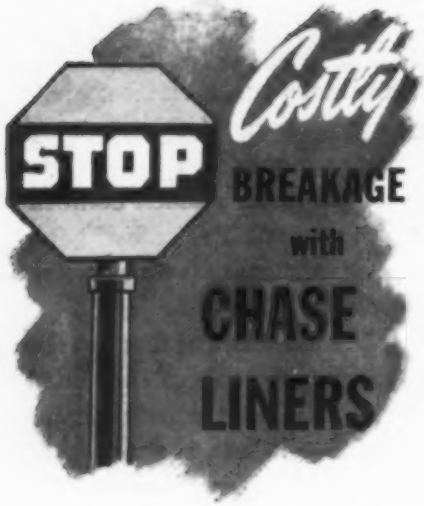
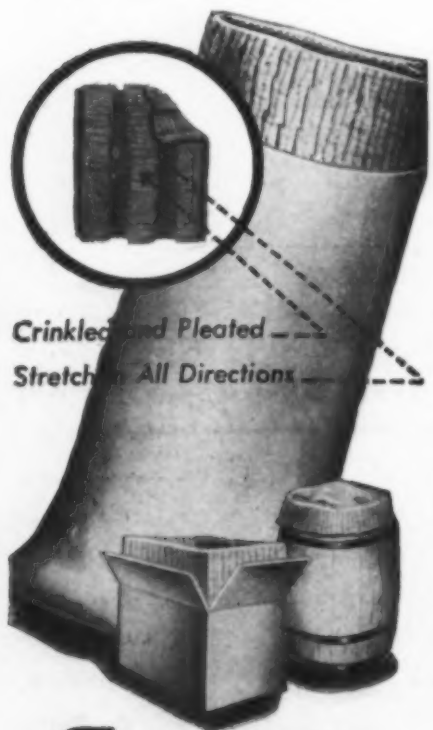


Chase Liners are crinkled and pleated. They're flexible, elastic — stretch in all directions. Provide greater protection, stop costly liner breakage. Check on Chase Liners today — it's the better product that costs no more than ordinary liners.



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withstand compression forces of 20,000 lb. per sq.in. It has been used to make such objects as tack hammers, art objects, lamp bases, electrical insulators, ash trays, desk sets, pipe holders, imitation jewelry (with metal plating), small jigs and fixtures, and other similar articles. Hardening or curing takes place at normal room temperatures if the plastics are allowed to remain in the mold for a day or so, but best results have been obtained by heating in an oven at temperatures of 150 to 200 deg. F. for periods of 2 to 6 hr. Actual curing time depends on the size of the cast, the exact temperature of the oven, and presence or absence of fillers. Small casts containing no fillers may be hardened at 160 deg. F. in 2 hr. Without fillers, however, this plastic does not have great strength properties. However, in this case it does not retain the air bubbles which often cause porosity and spoil casts. It may be hand worked or machined like wood after curing. The second of these two products is a rubbery, vinyl-base mold material which is claimed to have the qualities to produce accurate casts of plaster and many other materials. Known as Plastiflex, this material is a non-vulcanizable thermoplastic claimed to be superior to natural and synthetic rubber mold materials. Plastiflex molds are made by melting this elastomer and pouring over a model of the object to be cast. Hardening of a mold takes place in about 25 min., but this time may be reduced by quenching the mold in water. Various materials can be cast in these molds, including ceramics, plaster, cement, wax, and any other substance which can be melted or cured at temperatures of less than 230 deg. F. Plastiflex starts to soften at temperatures of more than 230 deg. F., and becomes fully melted at a temperature of about 300 deg. F. Thermoplastics which melt at temperatures under or over 230 deg. F. can be successfully cast if the whole mold is immersed in water as soon as the molten resins have been poured. No parting agents are required because the molds have smooth, non-porous surfaces and no adhesive properties.

SILICONE PAINT

Now UNDER development by the General Electric Co., Pittsfield, Mass., is a new silicone paint which can provide lifetime finish for automobiles, refrigerators, stoves, and hospital equipment. It is claimed to retain its original color and gloss indefinitely, and is expected to pave the way for brighter and more clear colors than heretofore available. Tests of the paint show that silicone is highly resistant to severe weather conditions, chemicals and heat. A three-year test of silicone painted panels conducted under most severe weather conditions has left the panels practically unaffected. It is claimed to resist acid and alkali solutions, retaining all its original characteristics.

SYNTHETIC DETERGENT

USING petroleum as a basic raw material, a new washing compound is now available from the Oronite Chemical Co., 225 Bush St., San Francisco, Calif. Tests have shown this product to be superior to many existing cleaners for common uses. It is expected to help relieve the present short-

WHAT IS LEKTROMESH?

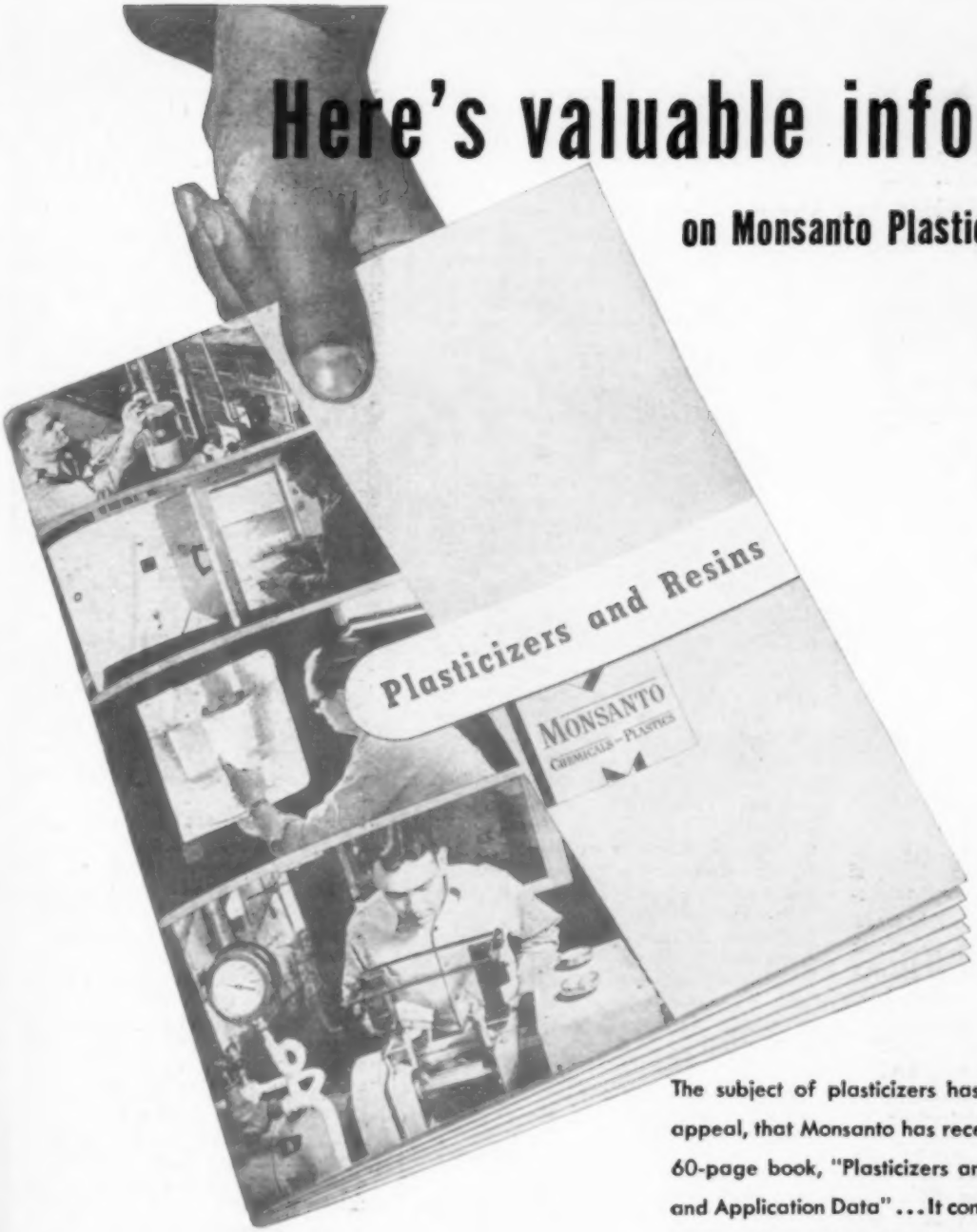
Lektromesh is metal screen made by electro-deposition .. a one-piece solid metal product with no woven structure to ravel. It is stiff, tough, and strong; in filters, strainers and other uses for industrial wire mesh it supplements woven mesh and is most applicable in the finer sizes beyond the limits of perforated metal. Lektromesh combines high accuracy of hole dimensions with a smooth surface, and is readily fabricated by drawing, stamping, welding, soldering or other processes. In sizes 40 to 400 mesh .. in standard rolls or fabricated into parts to your specification.

We will be pleased to send you samples of LEKTROMESH for your further consideration.

THE C. O. JELLIFF MFG. CORP.
Southport, Connecticut

Here's valuable information

on Monsanto Plasticizers and Resins



The subject of plasticizers has such wide and general appeal, that Monsanto has recently revised and issued a 60-page book, "Plasticizers and Resins — Specifications and Application Data" ... It contains much detailed information of considerable daily value — suggested uses, specifications, descriptions, tables, graphs, and various data on flash points, viscosities, pour points, solubilities ... A copy will be sent promptly on request. Contact the nearest Monsanto District Office, or write: MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri. District Offices: New York, Chicago, Boston, Detroit, Charlotte, Cincinnati, Birmingham, Los Angeles, San Francisco, Seattle, Montreal, Toronto.

Some Suggested Uses for Monsanto Plasticizers

Alkyd Resins • Benzyl Cellulose • Cellulose Acetate • Cellulose Acetobutyrate • Cellulose Acetopropionate • Chlorinated Rubber • Ethyl Cellulose Natural Resins • Neoprene • Nitrocellulose Phenolic Resins • Polystyrene • Polyvinyl Acetate Polyvinyl Butyral • Polyvinyl Chloride • Polyvinyl Formal • Protein Compounds (Soybean or Corn Protein, Casein, Glue) • Santolite Resins • Urea Formaldehyde Resins.

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"Utility" Filter

PRE-FILTRATION TO GERMPROOF AND ULTRA-FILTRATION

The Ertel "Utility" Filter is the only unit specially designed for use with any and all types of filtering mediums:

1. Ertel Neutral Asbestos Filter Sheets
2. Filter Cloth and Filter Aid
3. Filter Paper
4. Filter Cloth

Available in sizes holding from 10 to 100 filtering surfaces. Has no rubber gaskets or washers. The Ertel single hand wheel effects a simple complete closure. Equipped with pump, motor and pressure control. Engineering consultation without obligation.

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age of soap and is said to be effective in laundering fine fabrics, dishwashing, industrial cleaning, etc. It is also claimed to be useful as a basic ingredient in the textile, canning and dyeing industries, and for insecticides. It is available in commercial quantities

QUICK DRYING FINISH

A wood floor preservative and finish, known as Liquipol, claimed to penetrate, preserve, seal and finish all types of wood floors in one application has been announced by L. Sonneborn Sons, Inc., 88 Lexington Ave., New York, N. Y. This new product provides a satin gloss finish and is said to preserve wood resiliency, to be resistant to abrasion, chipping and cracking, and to be practically impervious to water and alcohol. The finish needs no thinning or special preparation. The treated area can be rubbed down within fifteen minutes after start of application. Waxing, if desired, can be done following the day of application.

COLOR FILM DEVELOPMENT AGENT

An important advance in color film processing is claimed to result from use of a new color developing agent for color films and color paper recently announced by the Ansco Div. of General Aniline and Film Corp., Binghamton, N. Y. While it is not yet available in commercial quantities for public consumption it will eventually be part of color-developing kits. It is claimed to overcome the disadvantage of causing skin irritations of commonly used preparations. It is no more toxic than the developer used in ordinary black and white photography, and it may be used in the same manner.

NON-SLIP SAFETY FLOORING

Now available from the chemical products division of the Goodyear Tire & Rubber Co., Akron, Ohio, is a non-slip safety flooring and protective covering material for metal, wood and concrete. Under the trade name of Griptred, this material, used widely during the war, has been converted to peacetime commercial uses. It consists of a combination abrasive aggregate and plastic binder which, during the war, was found to be invaluable on Navy vessels around gun mounts, on passageways, flight and hanger decks, and other places where safety under foot is needed. The material may be applied by trowel, spray gun or brush.

DDT LIGHT

A new application of DDT for killing insects has been developed by the DDT Lite, Inc., 3757 Wilshire Blvd., Los Angeles, Calif. The application consists of using 100 percent DDT crystals to impregnate a white flocking which is used to cover a screen or cage to cover light bulbs. Insects of all kinds, attracted to the light, perch on the flocking, absorb DDT and fly away to die. This new fly-killing device is available in two forms, a snap-on screen and a special light enveloped in a wire cage. The light must be kept out of reach of animals and children.

Up quality, down cost with ILLCO-WAY

DE-IONIZED WATER

(the modern low-cost equivalent of distilled water)

10,000 GALLONS FOR LESS THAN A DOLLAR*

ANOTHER ILLCO-WAY INSTALLATION: Pure water is produced by this compact ILLCO-WAY De-ionizer (flow rate: 180 gph) in an Eastern experimental laboratory. No fuel, no cooling water is required, no periodic dismantling for cleaning.

In hundreds of efficient plants today, modern compact Illco-Way equipment such as pictured above is producing pure water—the equivalent of distilled water, but costing *90% to 99% less than heat-distilled water!*

That's exactly the saving you make with Illco-Way De-ionizing equipment. Water produced is *uniform* at all times . . . is daily meeting exacting standards in pharmaceutical, chemical, cosmetic and industrial plants.

Units are designed to meet your needs; flow rates from 12 gph (portable unit) up to 500,000 gph . . . Investigate this process today—write for latest literature.

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INVENTED IN THE LABORATORY ILLCO-WAY PERFECTED IN THE FIELD

CHEMICAL ENGINEERING NEWS

NUCLEAR PHYSICS STUDIES AT CLINTON LABORATORIES

A NEW type of staff training program in advanced nuclear physics was started at Oak Ridge, Tenn., on September 15 when a selected group of 35 scientists and engineers began a year of study and research at the Monsanto Chemical Co.'s Clinton Laboratories.

During the program, the group will be employed by Monsanto Chemical Co., contract-operators of the laboratories, and will work with the full-time staff which has been engaged in the field of nucleonics for a number of years. In addition to Dr. Wigner and Dr. Seitz, the laboratory officials who will be closely associated with the program are: Dr. James H. Lum, executive director, Dr. Lothar W. Nordheim, director of the physics division, Dr. James R. Coe, Jr., director of the chemistry division, Dr. Miles C. Leverett, director of the technical division, and Dr. C. Rogers McCullough, director of the power pile division.

Scientists who will attend the school include Dr. John H. Buck, Socony-Vacuum Laboratories, Paulsboro, N. J.; Dr. Edward C. Campbell, Palmer Physical Laboratory, Princeton University; Dr. Herbert M. Clark, Rensselaer Polytechnic Institute; Dr. Karl Cohen, Esso Laboratories, Elizabeth, N. J.; Leonard Eisenbud, McLaughlin Carr Associates, New York; Lloyd Hunter, Westinghouse Electric Corp., East Pittsburgh, Pa.; Dr. S. Lawroski, Esso Laboratories, Elizabeth, N. J.; Stephen M. MacNeille, Tennessee Eastman Corp., Oak Ridge; Dr. Jordan J. Markham, Brown University; R. C. Mason, Westinghouse Electric Corp., East Pittsburgh; John R. Menke, Kellex Corp., New York; Prof. Roy F. Newton, Purdue University; Dr. Henry C. Ott, Rensselaer Polytechnic Institute; Dr. Sidney Siegel, Westinghouse Electric Corp.; Dr. W. I. Thompson, Standard Oil Development Co., New York; F. C. Vonder Lage, Washington, D. C., and R. M. Boarts, head of the University of Tennessee chemical engineering department.

JEFFERSON CHEMICAL TO MAKE ETHYLENE GLYCOL

ETHYLENE glycol and ethylene oxide are among the initial products which will be manufactured by Jefferson Chemical Co., Inc. The company was organized in November 1944 by the Texas Co. and American Cyanamid to produce chemicals from petroleum and petroleum gases. Construction of its first plant is well under way at Port Neches, Tex. Upon completion this plant will produce ethylene and various ethylene-derived chemicals, including the glycol and oxide, using as raw materials petroleum gases obtained from the nearby Port Arthur refinery of the Texas Co. Actual production is expected to begin during the summer of 1947. Construction of the plant itself is being handled by the Lummus Co. and E. B. Badger and Sons Co.

Jefferson has started a long term program of research on the synthesis of chemicals from petroleum in the company's New York laboratories and in its pilot plant in Texas. The staff now working at the pilot plant includes a number of production department trainees, who will make up the nucleus of the force which will operate the full scale plant along with members of the field staff which is now supervising the construction work.

CHEMICAL MARKET RESEARCH ASSOCIATION MEETS

ON September 17 the Chemical Market Research Association met in the Hotel Biltmore, New York, and heard speeches by M. H. Lockwood, president of the National Fertilizer Association; Dr. R. L. Hashe, Tennessee Eastman Corp.; and G. S. Armstrong, G. S. Armstrong Inc. Members also heard Robert Wittenberg, president of the association announce plans for meetings to be held this fall and winter. Among those scheduled are the Chicago meeting, October 31, at which time chemicals in the food industry will be the subject discussed and the New York meeting, December 12, at the Hotel Roosevelt, where a joint meeting with the technical service group will be the feature attraction. Plans for the February, 1947, gathering in Montreal, Canada, also were explained in general terms. Due to the large number expected to attend the December meeting all reservations should be submitted to Logan Grupelli, National Oil Products Corp., Harrison, N. J., before November 1.

REPORT ON I. G. FARBEN CHEMICAL FORMULAS

CHEMICAL formulas and detailed information on the manufacture of inorganic and organic chemicals at the I. G. Farbenindustrie plant at Leverkusen, Germany, are contained in a report now on sale by the Office of Technical Services, Department of Commerce. Prepared for the Combined Intelligence Objectives Sub-Committee by L. C. Turnock and F. R. Lowdermilk, the 87-page report describes industrial uses for the wide variety of organic and inorganic chemicals produced at Leverkusen, as well as manufacturing methods, unit costs, and power requirements for production. Numerous flowsheets are included.

The inorganic chemical compounds and processes discussed in the report include: barium compounds, carbon and chlorinated carbon compounds, ceramic colors and fluxes, activated charcoal, chlorine, sodium hydroxide and hydrogen, chromium compounds, chromizing of steel surfaces, fluorine and fluorine compounds, hydrazine hydrate, hydrogen chloride, lithopone, oxygen, sodium compounds, sulphur-chlorine compounds, titanium compounds, vanadium pentoxide, zinc compounds, and zirconium compounds.

The organic chemicals described in the report are: phenol, diphenyl, diisocyanates, tanning agents, amines, chlorinated hydrocarbons, piperidine, rubber accelerators, rubber antioxidants, and resins.

Orders for the report (I. G. Farbenindustrie, A. G., Leverkusen; PB-6687; photostat, $6; microfilm, $1) should be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D. C.

H. K. FERGUSON WILL BUILD CHLORINE PLANT IN INDIA

CONTRACTS covering design, purchasing and construction supervision for a chlorine plant for the Delhi Cloth & General Mills Co., Ltd., at Delhi, India, have been awarded the H. K. Ferguson Co. of New York, Cleveland and Houston. The plant will be owned by Indian interests and in addition to chlorine will produce caustic soda and hydrochloric acid. The original installation will have a daily capacity of 10 tons of chlorine with provision for enlarging the capacity in the future. Salt will be obtained from a source near Khewra, India, about 200 miles from Delhi. The chlorine made will be used by the owner as a bleaching agent for textiles and also will be made available for industrial applications in the Delhi area.

MARATHON CORP. TO BUILD RESEARCH LABORATORY

AN announcement by D. C. Everest, president and general manager of Marathon Corp., states that the company has completed plans for the erection of a modern research laboratory at Rothschild, Wis., to accommodate research and pilot studies on pulp paper and chemical products. Dr. Allen Abrams, vice president and coordinator of company research, developments and patents, will be in charge of the laboratory which is expected to be built in 1947.

Dr. Abrams, who continues in charge of the company's chemical division, said that extensive research is being carried on to make additional products from lignin. The chemical division recovers about 15,000 tons of ligneous material annually from spent sulphite liquor. At present this material is used for making dispersing agents, water treating compounds and tanning agents. In addition nearly one-half of

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INDUSTRIAL DIVISION

CONTINENTAL GIN COMPANY

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domestic vanillin is made from the lignin recovered at Rothschild. A new unit, expected to get into operation in the latter part of this year, will make a new water treating material for use in high pressure boilers.

QUALITY CONTROL SESSION HELD AT ROCHESTER

CONTROL engineers from 11 U. S. and Canadian firms attended the intensive course in Quality Control of the Chemical Industries, given by Rochester Institute of Technology in Syracuse September 10-18.

Tennessee Eastman was represented by E. L. Gustafson and G. W. Hakanson; Resinous Products & Chemical Co. of Philadelphia by Robert Marvin; Dow Chemical Co. by Floyd V. Coe; Bristol Laboratories, Inc., by Dr. Abram Slesser, John Goodman, John Kressman, Sylvan Falck, Arthur Sporn, Robert Ellis, Samuel Soll, Philip Steensland, Dr. W. L. Gaby, and Frank W. Staab; Ansco Corp. by Emory M. Kurtz, Maurice G. Anderson, and Paul B. Means, Jr.; North American Rayon Corp. by Karl T. Schaefer and Wil-

CONVENTION CALENDAR

Engineering Society of Western Pennsylvania, seventh annual water conference, Hotel William Penn, Pittsburgh, Pa., October 28-30.

American Oil Chemists' Society, annual fall meeting, Edgewater Beach Hotel, Chicago, Ill., October 30-November 1.

Chemical Market Research Association, Palmer House, Chicago, October 31.

Federation of Paint and Varnish Production Clubs, annual convention and paint industries show, Hotel Claridge, Atlantic City, N. J., November 4-6.

National Paint, Varnish & Lacquer Association, annual convention, Atlantic City, N. J., November 6-8.

American Institute of Chemical Engineers, annual meeting, Bellevue Stratford Hotel, Philadelphia, Pa., November 17-20.

National Metal Exposition, Municipal Auditorium, Atlantic City, N. J., November 18-22.

American Council of Commercial Laboratories, annual meeting, Palmer House, Chicago, Ill., December 2-3.

Seventeenth National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York, N. Y., December 2-7.

Seventh International Heating and Ventilating Exposition, Lakeside Hall, Cleveland, Ohio, January 27-31, 1947.

Society of Plastics Engineers, convention, Congress Hotel, Chicago, Ill., January 28-February 2.

American Society For Testing Materials, spring meeting, Benjamin Franklin Hotel, Philadelphia, Pa., February 24-28.

Second National Plastics Exposition, Coliseum, Chicago, Ill., May 5-11.

WHERE TOUGH COATINGS ARE REQUIRED—PENTEK*

Paint and varnish coatings processed with PENTEK will help prolong the life of any weather-exposed equipment. It makes coatings not only tougher and more durable with greater resistance to moisture and alkalis, but also makes the coatings quicker bodying, faster drying, and more glossy.

PENTEK is a technical grade of Pentaerythritol which consists of approximately 85% mono Pentaerythritol and 15% higher polymers.

Write for technical data sheets, and other information on the use of PENTEK in paint and varnish formulation.

*Trade Mark Reg. U. S. Pat. Off.

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paint <u>has</u> to be tough!

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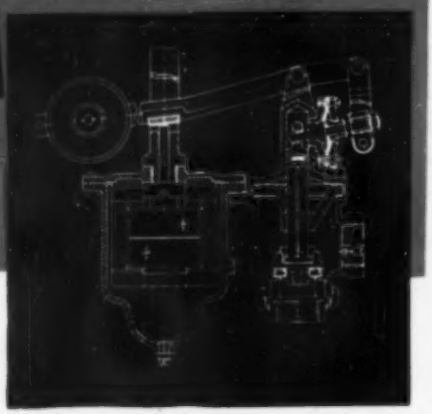
an example



• Don't confuse Davis industrial-type Solenoid Valves with ordinary low cost commercial types. Davis products are engineered to handle the "tough jobs" on a basis of SATISFACTION GUARANTEED. The Davis line is complete—standard and special designs are available for every conceivable kind of automatic control application.

Our Engineering Department is always ready to assist in solving any problems regarding the use of Solenoid Valves. When submitting your problem, give complete information so that the proper valve may be selected for the service. State size of valve, whether globe or angle pattern, nature of fluid or gas, temperature, maximum and minimum pressures, service for which valve is to be used, whether valve is to be open or closed when solenoid is energized, standard or explosion-proof solenoid box and current characteristics. DAVIS REGULATOR CO., 2539 S. Washtenaw Ave., Chicago, Ill.

No. 97 SL

✓ **Completely Sealed Valve Mechanism.** Valve stem is connected to solenoid lever through patented "DIA-BALL" packless joint. Widely favored for handling inflammable or toxic gases or liquids.

✓ **Self-Cleaning Design.** Can be used successfully for handling heavy, sticky materials because the valve interior is simple, port area large, and outlet downward, thus taking advantage of natural gravity flow. Note that valve seat is removable for cleaning merely by loosening union connection on bottom outlet.

✓ **Explosion-Proof Solenoid Housing.** Solenoid coils can be supplied for any current characteristics.

✓ **Renewable Valve Disc.** Supplied with composition or metal disc to suit particular requirements. Wide choice of materials available for valve and trim.

✓ **Visible Action.** Note that valve action is visible and can be tested by hand. In an emergency the valve can be manually operated.

DAVIS REGULATOR COMPANY

liam A. Sutherland; Rohm & Haas Co. by W. J. McNabb, Aluminum Co. of Canada by D. F. Nasmith; Solvay Process Co. by H. C. Britton; Rubberset Co. Ltd. of Canada by Barry Elliott; and the Sealright Co. by C. E. Foster.

Alfred L. Davis of Rochester Institute of Technology was coordinator of the course, and the instructors were Charles A. Bicking of Hercules Powder Co., Wilmington, Del.; Dr. Martin A. Brumbaugh of the University of Buffalo; Edward R. Close of Bausch & Lomb Optical Co.; Dr. Geoffrey Broughton of Eastman Kodak Co.; Roland H. Noel of Bristol Laboratories, Inc.; W. L. Gore of E. I. du Pont de Nemours & Co.; M. D. Gross, formerly with the U. S. Rubber Co.; Robert T. Knoll of Scott Paper Co.; and Dr. Grant Wernimont of the Eastman Kodak Co.

The course emphasized the types of tests and statistical analyses of greatest value in maintaining quality control in various types of chemical work, the value of quality control from the management viewpoint, and the methods of installing a modern quality control system.

CHICAGO PAINT & VARNISH GROUP ELECTS OFFICERS

At the September meeting of the Chicago Paint & Varnish Production Club the election of officers for the 1946-1947 season was held. The following officers were elected: president, H. H. Zimmerman, Illinois Paint Works; vice-president, T. A. Thorson, Minnesota Linseed Oil, Paint Co.; secretary, E. A. Wilder, S. C. Johnson & Son; and treasurer, P. deLeeuw, Nubian Paint & Varnish Co.

SEVENTEENTH NATIONAL POWER SHOW COMING TO NEW YORK

First reports from the list of almost 400 exhibitors booked for the 17th National Exposition of Power and Mechanical Engineering reveal that a large demand is expected for both standard products and new lines to be unveiled at the exposition, which is to be held in the Grand Central Palace, New York, December 2-7. Lists of exhibits already compiled constitute an extensive catalog covering all kinds of industries from the standpoint of their power needs and also processing services as fuel, heat, steam, air and water supplies, materials handling and others. A great majority of exhibitors have participated in former Power Shows and are returning with the first of their postwar products.

New designs will be featured by most of the exhibitors, with emphasis on the use of specially selected materials including a number of the new special alloys, and, where weight saving is an object, combinations of light pressed steel shapes with aluminum and occasionally magnesium. Makers of many items, such as valves, will offer interchangeable parts of various metals in otherwise standard units affording selectivity according to the type of fluid to be handled and the temperature and pressure requirements involved.

Included in the great variety of instruments and special purpose appliances will be many which have a wide range of appli-

You saw them go out...

These samples of Alcoa Aluminum Alloys, selected to meet corrosive conditions anticipated in a processor's plant, were shipped out early in 1945. After months of exposure, they were returned to Alcoa to tell their own story.

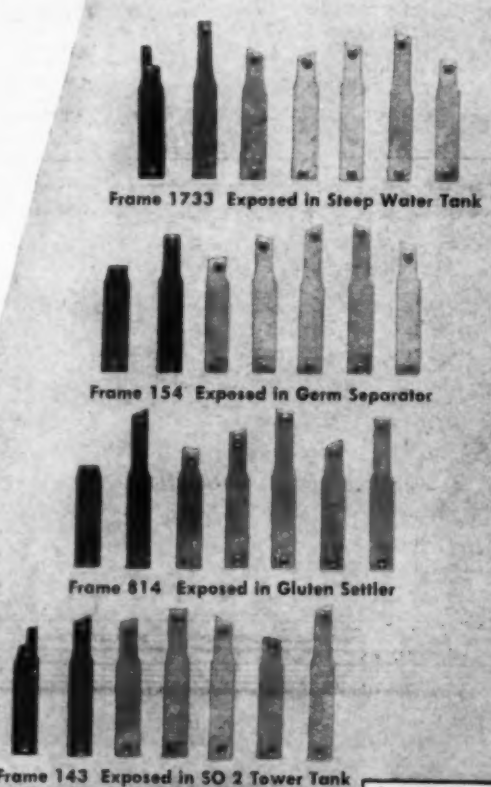
"We treated them rough" when they came back

Test pieces were taken from each sample and checked for tensile strength and depth and character of corrosive attack. The alloy which showed up best won the assignment, and it's now at work in that plant.

The point is —

Alcoa has a wealth of performance data on aluminum. From these data, we can often make definite recommendations on alloys to use in the equipment you're planning. Sometimes, however, months of testing must precede the selection of a material.

Therefore, if you're planning new equipment, why not ask Alcoa's advice *now* on the metal to make it of? Call the nearby Alcoa office, or write ALUMINUM COMPANY OF AMERICA, 2151 Gulf Building, Pittsburgh 19, Pa.



Frame 1733 Exposed in Steep Water Tank

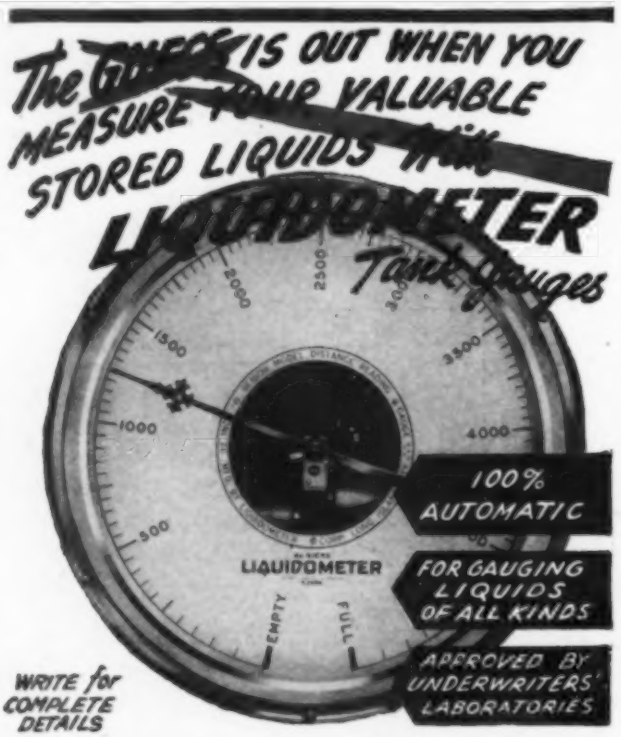
Frame 154 Exposed in Germ Separator

Frame 814 Exposed in Gluten Settler

Frame 143 Exposed in SO 2 Tower Tank

ALCOA FIRST IN ALUMINUM

IN EVERY COMMERCIAL FORM



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Conventions at the MORAINE HOTEL afford the happy combination of concentrated effort and luxurious rest.

Of graceful Georgian architecture and early American appointments, in an inspiring setting of ravine woodland on the shores of Lake Michigan, the MORAINE just naturally makes business a pleasure.

Our facilities conveniently accommodate groups up to 150 persons . . . Memberships are available in our popular Beach Club . . . Additional information will gladly be submitted upon request.

HOTEL Moraine -ON-THE-LAKE
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cations. For example, air-hydraulic presses may be used in assembling, embossing, crimping, riveting, heat sealing, marking of metals, leather and plastics; high-pressure pumps applicable to boiler feeds are aligned with pumps for injection molding, die casting, and numerous applications in steel and processing plants.

DUPONT TO BUILD PLANT AT WEST TOLEDO

When government authorization is received and materials are available, construction will be started by E. I. du Pont de Nemours & Co., on a new plant at West Toledo, Ohio. When the new facilities are completed, chemical specialties wil be produced and G. W. Sherin, manager of specialties sales, said that some 30 items will be made there including household cement, cleaning fluid, refrigerator polish, chrome and metal polish, hand protective cream, as well as a line of automotive maintenance products such as polishes, waxes, cooling system cleaner, and sealer and rust inhibitors. The new plant will cost approximately a million dollars and will be erected on the same site as the company's present finishes plant.

This announcement followed an earlier report that the co.npany planned to spend a million dollars on a new unit at the former Grasselli works on Matzinger Road, Toledo, for the manufacture of formaldehyde.

COMMERCIAL SOLVENTS BUYS DIXIE ORDNANCE PLANT

Dixie Ordnance Works, Sterlington, La., has been purchased by the Commercial Solvents Corp. from the War Assets Administration. The plant was constructed for the Ordnance Department and operated during the war by Commercial Solvents to produce anhydrous ammonia from natural gas. It will resume production as soon as possible. Ammonia from the plant should be available before the end of this year. The plant also will become a source of raw materials to the company for the manufacture of nitroparaffins and other chemicals. C. C. Boardman will be resident manager of the unit. J. E. Wheeler will be plant manager; J. R. Troeltzsch, production superintendent; and Olin Manhart, plant engineer.

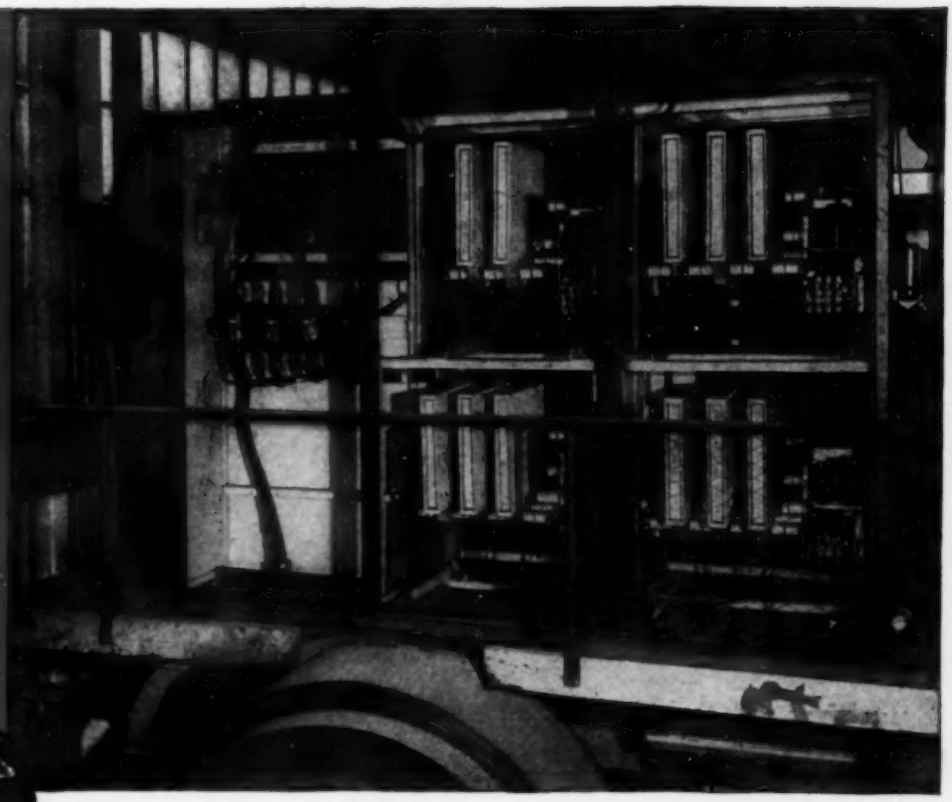
ACS EMPLOYMENT SERVICE OF NATIONWIDE SCOPE

With the opening of a New York regional employment clearing house for chemists and chemical engineers, the American Chemical Society has completed organization of a nationwide employment service for the chemical profession with offices in seven key cities.

Similar in purpose to the clearing house conducted at the Society's national meetings each spring and fall, the regional service will function throughout the year as a liaison agency, bringing together employers looking for chemists and chemical engineers, and Society members and student affiliates desiring such contacts. One of the immediate aims of the service is to

IT'S FAST IT'S TRIM IT'S RELIABLE

G-E High-voltage LIMITAMP CONTROL



This is the back view of a factory-assembled Limitamp unit. It controls the 300/600 hp synchronous motor which drives a Banberry mixer in a rubber mill. This mill represents only one of the many different industries for which Limitamp Control, designed for severe duty, is ideally suited.

This attractive, easy-to-install unit is a single Limitamp controller.

Here is a co-ordinated control that provides *outstanding* protection for high-voltage motors.

EJ-2 FUSES cut off a rise in current, resulting from a short circuit, in less than *one-quarter cycle* and clear it in less than one-half cycle—long before the short has time to harm the contactor or motor. And this operation takes place silently—without startling workmen.

AIRBREAK CONTACTORS designed for severe repetitive service, are co-ordinated with the EJ-2 fuses. These contactors give dependable, low-cost operation with little maintenance. Operating experience has proved that they furnish reliable service with only routine inspection—*even after several million operations.*

PROVIDING OVERLOAD AND UNDERVOLTAGE PROTECTION, this control guards the motor against overheating due to sustained overloads or single phasing by isothermic overload relays which are accurately calibrated against actual motor characteristics.

YOU'LL WANT complete details about Limitamp controllers—special features, different types of enclosures, ratings, etc. Ask our local office for Bulletin GEA-4247 or write directly to *Apparatus Dept., General Electric Company, Schenectady 5, New York.*

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It May Save you thousands of dollars in Preventing Breakdowns and Fires . . .

Removal of tramp iron from material in process is a must now as the Prater Certified Permanent Magnet makes the cost so low.

Tramp Iron leads to breakdowns of equipment, contamination of material, fires from sparks or overheated metal.

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help alleviate the present critical shortage of technical manpower in the industrial and educational laboratories of the nation.

The New York office, which will serve the Middle Atlantic region, has been set up in Room 93 in the Chemists' Club Building, 50 East 41st Street, under the direction of Dr. Walter Baeza, a member of the Society's National Council. The service has its headquarters in Washington at 1155 16th Street, N. W., and also maintains offices in Atlanta, Boston, Chicago, Houston and San Francisco.

J. C. E. TO HEAR ARNOLD ON SYNTHETIC GASOLINE

SYNTHETIC gasoline from modifications of the Fischer-Tropsch process will be the subject of an address by Dr. John H. Arnold, to be delivered at the regular monthly dinner meeting of the Junior Chemical Engineers of New York on Nov. 13. A dinner at 7 p. m. and the meeting at 8 will be held at the Terminal Cafe, New York.

DUPONT RENAMES NYLON RESEARCH LABORATORY

AT A simple noon-day ceremony held on September 17, the nylon research laboratory at Wilmington was dedicated as The Carothers Research Laboratory in honor of the late Wallace Hume Carothers who headed the team of scientists that first synthesized nylon. Jane Carothers, young daughter of the distinguished scientist, unveiled a bronze plaque that commemorates the researches of her father on the structure of polymers and the invention of nylon. Tribute to Dr. Carothers, who died in 1937, were paid by Dr. E. K. Bolton, B. M. May, and Dr. G. P. Hoff.

WATER TREATMENT METHODS DISCUSSED AT SAVANNAH

MORE than 150 water supply engineers from every state in the southeast were present at the three-day annual meeting of the Southeastern Section of the American Water Works Association recently held at Savannah, Ga. At the business session, W. H. Weaver, general manager of the DeKalb County Water System, Decatur, Ga., was elected new section chairman; W. R. Wise of South Carolina, vice chairman; and W. T. Linton, sanitary engineer of the South Carolina Board of Health, secretary. B. P. Rice, supervisory engineer Self Liquidating RFC, Atlanta, retired as secretary after nine years of service.

The use of chlorine dioxide as a means of eliminating odors and tastes in water systems was recommended by F. W. Chapman, superintendent of the Water Department, Greenwood, S. C. He said that this community drew its water supply from an artificial shallow lake supplied by a rather small stream and a taste and odor problem always existed, usually worse in warm weather. Numerous treatments were tried with varying results. In October 1944, a chlorine dioxide generator was installed and upon completion of the first cycle, all traces of tastes and odors disappeared.

J. A. Holmes of National Aluminate

Check THESE NEW USES FOR ION EXCHANGE!

- ☐ **REMOVAL** of undesirable impurities from solutions.
- ☐ **CONCENTRATION** of valuable substances to make their recovery commercially feasible.
- ☐ **SEPARATION** of desired substances from each other.
- ☐ **CATALYSIS** of chemical reactions.
- ☐ **SUBSTITUTION** of specific ions for other ions in solution.

Industry finds many uses for this new unit process!

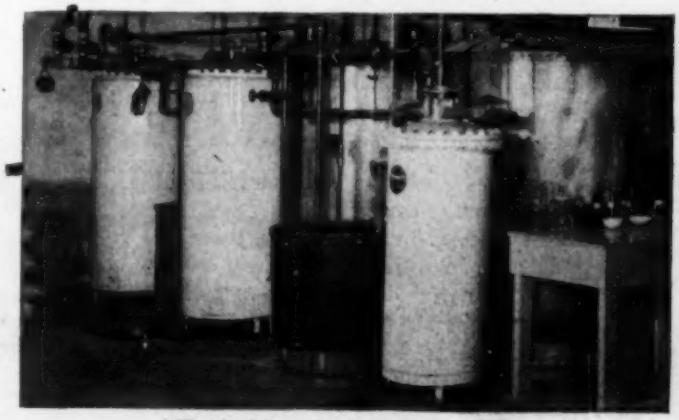
With Permutit's* development, in recent years, of improved ion exchangers, chemical engineers have found numerous uses for this *new* unit process, beyond the field of water treatment.

Today, Permutit's Ion Exchangers are at work in such diversified fields as: sugar manufacturing, alkaloid recovery, the manufacture of vitamin extracts, the removal of harmful metallic ions from foodstuffs, the recovery of valuable pectin from grapefruit wastes.

The principles of ion exchange offer vast industrial application. Permutit's pioneering research in this field, coupled with its experience in the construction and installation of ion exchangers may help you put this new unit process to work in your own industry.

Write for free, informative booklet, "Ion Exchangers For Industrial Processes," The Permutit Company, Dep't CM10. 330 West 42nd Street, New York 18, N. Y., or Permutit Company of Canada, Ltd., Montreal.

*Trademark Reg. U.S. Pat. Off.



A Typical Ion Exchange Installation

FOR MORE THAN 30 YEARS

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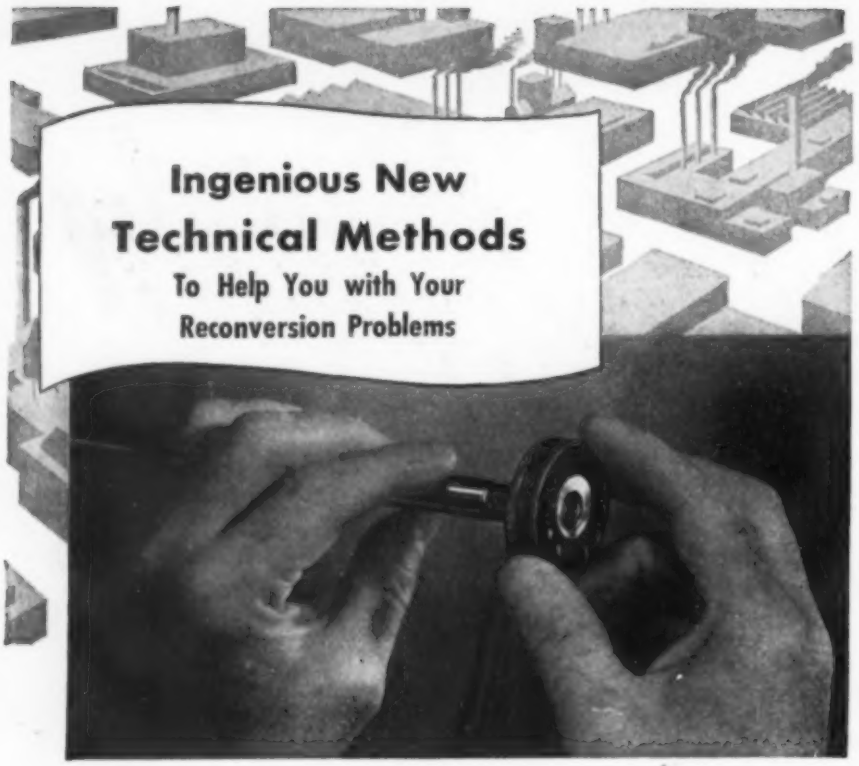
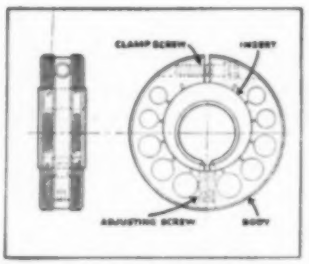


New Thread Ring Gage Starts Round *Stays Round* with Every Adjustment!

Employing a new principle of design, the Woodworth Thread Ring Gage closes in round within .0002 maximum after .005 adjustment. It offers greater accuracy and stability since size adjustment is controlled along thread helix angle. Threads are held securely in alignment after adjustment, due to unique adjustment means. Wear is distributed over full circumference for all resettings, thus increasing life of gage.



Woodworth Thread Ring Gage

Positive adjustment makes it almost impossible to change setting with ordinary knocks. Positive identification by a green "go" gage and red "not go" gage saves operator time. Aluminum alloy outer body cuts weight in half, to reduce operator fatigue and increase sensitivity.

To also reduce fatigue on precision jobs, many plant owners make chewing gum available for workers. Tests show that the act of chewing aids in relieving tension, which is often the cause of fatigue. These tests further reveal that chewing Wrigley's Spearmint Gum, for instance, helps workers stay alert, thus increases their efficiency to do more accurate work.

You can get complete information from
N. A. Woodworth Company
1300 East Nine Mile Road, Detroit 20, Michigan

AA-95

Corp., in discussing the practical approach to scale corrosion in potable water supplies, said that scale was defined as incrustation or deposits formed by calcium and magnesium compounds. He said that if stability index is between 6.0 and 4.0, the use of polyphosphate type of treatment is advisable. Below 4.0 the tendency for scale formation is so great that it is advisable to presoften or otherwise lessen the effect of one or more factors on the side of the balance that causes the scale to the point where an economical dosage of polyphosphate treatment can be used. He said that his experience was that silica naturally present in water was a better protector against corrosion than added silicates.

ALIEN PROPERTY CUSTODIAN ISSUES NEW REGULATION

ALIEN property custodian James E. Markham has issued a general order prohibiting any interest in stock in designated key corporations, seized by the APC, from being transferred to or acquired by any person not an American national. The regulation, (APC General Order No. 35), provides that certain business enterprises in which stock is held by the APC and which are vital to the defense economy of the United States will be designated "key corporations" and restrictions will be placed on the resale of the vested shares.

In issuing the order, Mr. Markham explained that in many instances shares of stock seized by the APC in the first World War and, subsequently sold by him to Americans, were found at the time of World War II to have again come under enemy ownership as the result of intermediate sales or transfers. Under the order each "key corporation" is required to furnish APC periodic lists of the names and addresses of the holders of record of the stock vested and sold by the custodian.

PABST BREWING CO. EXPANDS RESEARCH PROGRAM

UNDER the direction of Dr. Alexander Frieden, who recently joined the company, The Pabst Brewing Co. is launching an extensive program of reasearch. A new building is now under construction in Milwaukee and it will house the present groups consisting of a bacteriological laboratory headed by Dr. J. C. Hoogerheide; a biochemical laboratory headed by Dr. Harold Levine; a physical chemistry laboratory headed by Dr. W. D. Claus; an organic chemistry laboratory headed by Dr. S. A. Morell; and a chemical engineering laboratory headed by P. Deren. In addition it is contemplated to set up a division for fundamental studies on flours and starches. The applied laboratories will have units on textiles, paper, adhesives, and food.

HEYDEN CHEMICAL ACQUIRES MEMPHIS PHENOL PLANT

ACQUISITION of a phenol plant in Memphis, Tenn., is the latest step in the integration of the $25,000,000 Heyden Chemical Corp. The new acquisition, which will produce synthetic phenol, will

NOW AVAILABLE IN COMMERCIAL QUANTITIES

Epichlorohydrin

CONSIDER THIS HIGHLY REACTIVE INTERMEDIATE

Availability of Epichlorohydrin (1-Chloro-2,3-epoxypropane) in tank car quantities offers many new opportunities to the chemical industry.

Epichlorohydrin reacts through its epoxide structure with a variety of compounds possessing "active" hydrogen atoms, including: water, acids, phenols, alcohols, mercaptans, ammonia, and amines. In these reactions the epoxide ring opens at the terminal carbon atom to give alpha-gamma substituted derivatives of glycerin.

Since the chlorine in Epichlorohydrin is also reactive, varying combinations of the epoxide ring, chlorine atom, hydroxyl group, amine radical, ether linkage and ester structure are possible *in the same molecule.*

In addition, a wide variety of substituted polyethers can be obtained by polymerization of Epichlorohydrin or its epoxy derivatives.

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WITH

THE MASTER OF FLAME
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FIRE EXTINGUISHERS

Greatly increased fire-killing capacity.

Simplified operation.

Expert performance by inexperienced operators.

Quick, easier on-the-spot recharge after use.

More fire stopping power pound for pound, dollar for dollar.

Greater heat-shielding protection for operator.

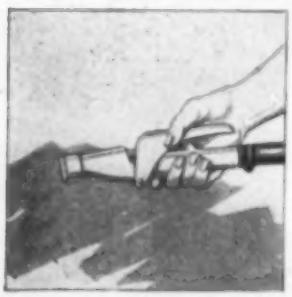
Increased fire-fighting capacity without increased weight.

Engineered to resist corrosion.

Install the NEW Ansul-Dugas Extinguishers at all hazard spots for greater protection against all fires involving flammable liquids, gases and electrical equipment.

Ready... in a Flash!

- Simply remove ringpin and push lever down.



- Open nozzle and direct chemical stream at base of flames.

53% More...

FIRE STOPPING POWER

with the NEW FASTER ACTING

ANSUL-DUGAS

FIRE EXTINGUISHERS

Write today for new catalog and authoritative data showing characteristics of all types of approved hand fire extinguishers.

Listed and Approved by Underwriters' Laboratories and Factory Mutual Laboratories.

ANSUL CHEMICAL COMPANY
FIRE EXTINGUISHER DIVISION • MARINETTE, WIS.

further round out the Heyden line of basic chemicals now being turned out in plants throughout the country under the direction of B. R. Armour, president.

The Memphis plant, located on a 68-acre site within the city, was purchased from the War Assets Administration for $1,060,000. Known as the Southern Acid and Sulphur plant, it was built during wartime but never got into operation. Heyden expects to begin production by November 15. The process to be used involves production of caustic soda and chlorine, chlorbenzene and, finally, phenol. This will be shipped elsewhere for conversion into salicylic acid. A byproduct will be hydrogen for use in the hydrogenation of vegetable oils for shortening and cooking oils. The raw materials used will include benzene and salt from nearby Louisiana mines.

READERS' VIEWS and COMMENTS

BATCH SIZE vs. PRODUCTION RUN

To the Editor of Chemical Engineering:

Sir:—In the past I have filled in questionnaires on your magazine. These were concerned mostly with comment and criticism. I take it by that, that you are continuing to look for further expressions of pleasure and displeasure from your readers.

With this prelude, I will proceed forthwith to discuss the article "How To Determine Economical Batch Sizes." This appeared on p. 137 of the July 1946 issue. I believe the article is incorrectly titled, since the author appears to have meant length of production run instead of batch sizes. I could see nothing in the article to refute my previous opinion that the largest batch that is mechanically feasible for the particular equipment is the most economical, providing of course that the rest of the equipment for the process is in proper phase.

I think equation (3) should have come before equation (2). The c/300 factor was rather puzzling until I had decided to read further. Although it is only an assumed value, $16 is an astonishingly small amount to assign for an industrial changeover, especially if idle labor and equipment factors were considered (were they?). In the Specific Examples, one detailed calculation would certainly have been enough.

I think the idea presented in balancing inventory costs vs. changeover expenses is an interesting one for those who might operate in this manner.

L. P. WENZELL

Monsanto Chemical Co.
Monsanto, Ill.

A SECOND SCHOOL OF THOUGHT

To the Editor of Chemical Engineering:

Sir:—Mr. S. E. Andersen's article in the July 1946 issue of *Chemical & Metallurgical Engineering*, "How to Determine Economical Batch Sizes," was most interesting. The reasoning was easy to follow, and the final formula was simple enough to be readily usable.

Although you made no claim of absolute accuracy and were careful to point out the

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limitations of the formula, it should be sufficiently accurate for many uses. However, I believe that one change might be made which would increase the accuracy of the formula without impairing its simplicity. Your equation (2) carries the implied assumption that each unit will be carried in inventory for the entire period between production of individual batches. I believe it would be more reasonable to assume shipment of the manufactured material at a uniform rate. On this basis, one unit would, on the average, be carried in inventory for only half the period between batches, and the investment cost would be half the amount shown. This could be recognized by introducing a factor of $\frac{1}{2}$ in equation (2), which would cause the formula (5) to read thus:

$$x = 10(6ab/c)^{\frac{1}{2}}$$

This properly neglects minimum working stocks, which we assume to remain constant under all conditions. The cost of investment in this material is just overhead, a part of the cost of doing business, and is not affected by batch size. It is only fair to admit that shipments will not be made in infinitesimal amounts, but in discrete quantities. It appears, therefore, that the truth will fall somewhere between your assumed conditions and mine. I feel that my assumption will, in general, approximate the actual circumstances more closely.

W. H. Buell

Union Oil Co. of Calif.
Los Angeles, Calif.

MORE ON BATCH SIZES

To the Editor of Chemical Engineering:

Sir:—To answer Mr. Wenzell's comments, I would like to point out that the largest batch that is mechanically feasible is not necessarily the most economical, if it is going to give you an oversupply of stock.

"Length of production run" versus "Batch size" is a matter of terminology in this case. If a certain amount to be manufactured is decided upon, it might be made in one charge and then again it might be necessary to run several charges if equipment of large enough capacity is not available. Equation (3) is an explanation of how we arrived at equation (2).

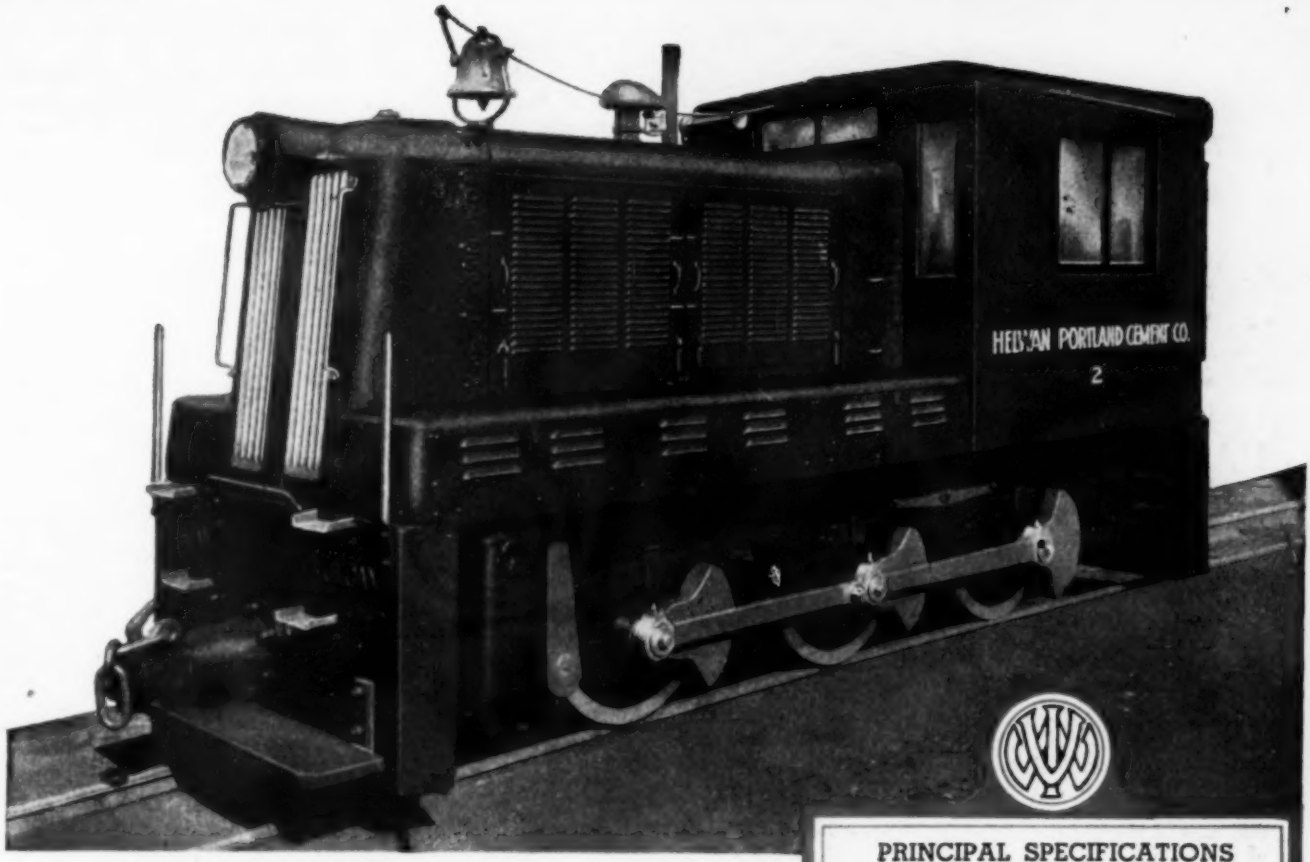
Sixteen dollars is not too far off when you consider that the job change might only involve steaming out some stills, which might be the case in the manufacture of most liquid aromatics. As to the use of the specific examples, I felt that it was necessary to give all four in order to show the influence of variations in unit cost and sales.

My article was meant for those who operate the relatively small batches. Apparently, Mr. Wenzell is used to the production of very large batches to which my formula may not apply.

Mr. Buell's letter is very instructive. Probably the suggestion he makes would increase the accuracy of the formula, although as he says, the truth will fall somewhere between his assumed conditions and mine.

S. E. Andersen

Givaudan-Delawanna, Inc.
New York



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Maximum Safe Speed, miles per hour	20

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One Six-Cylinder Full Diesel Engine rated 150 hp. at 1000 r. p. m.
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One Westinghouse Single-Station E. M. Control

DIMENSIONS

Track Gauge	29½"
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Length, over bumpers	17'-6"
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At last ready to operate is this $3,000,000 plant at Springfield, Ore., to produce industrial alcohol by weak acid hydrolysis of sawdust and other wood waste. 220 tons of dry waste per day will produce 11,500 gal. of ethyl alcohol and 60 lb. of lignin

PACIFIC PROCESS INDUSTRIES

TRENDS • EVENTS • DEVELOPMENTS

JOHN R. CALLAHAM, Pacific Coast Editor, San Francisco, Calif.

WOOD HYDROLYSIS ALCOHOL PLANT READY TO RUN

After still another delay caused by lack of electrical starters for motors, the $3,000,000 alcohol-from-wood-waste plant at Springfield, Ore., is now ready for its shakedown run. Authorized in 1944, construction was begun in 1945 but since the war's end has consisted largely of a series of delays. The plant, now under sponsorship of the U. S. Forest Service, was built by DPC funds but is to be leased and operated by the Williamette Valley Wood Chemical Co., composed largely of Eugene lumbermen. The plant will use a modified Scholler process of wood hydrolysis, considerably improved by the Forest Products Laboratory at Madison, Wis.

Raw material will be sawdust and other wood waste, probably at a cost somewhat above $2 per ton. Some 220 tons of dry waste will be used daily to produce about 11,500 gal. of 190-proof alcohol. This yield of 52 gal. per ton may be increased to 58-62 gal. About 600 lb. of byproduct lignin will be produced from each ton of wood. In the process, wood waste will be charged to five Herculoy-lined vertical percolators each capable of holding 25,000 lb. of dry charge. Dilute H_2SO_4 percolates through the wood in several batches under steam pressures from 50-150 lb. per sq. in. Acid concentration is about 0.8 percent for the first percolation and 0.4 percent for the last; total percolation cycle is about six hours. Lignin is blown into a cyclone, pressed to reduce moisture, and used as fuel under the boilers. Acid percolator liquors are flashed at 35 lb. per sq. in., neutralized with lime, filtered, and flashed in three stages. Residual liquor, after addition of nutrients, contains about 4 percent fermentable sugars and is fermented at 86 deg. F. Alcohol in the beer, about 2 percent by weight, is recovered and purified in the conventional manner. Products include 190-proof alcohol, about 5 gal. of 190-proof "heads" per ton of wood, and a very small quantity of fusel oil.

Long-term economics of the plant and process are questionable. The product is competitive with grain alcohol at present. Its status in a more normal economy might be a different matter, and at a probable cost of at least 30c. per gal. it would certainly not be competitive with alcohol from petroleum or sulphite liquor and probably not with molasses alcohol. Future of the process may hinge upon developing profitable uses for the byproduct lignin, such as an extender for plywood glues, insecticide carrier, fertilizer, chemical raw material, since its sale at 1c. per lb. would reduce alcohol costs by 10c. per gal. A lot of work has been done on this problem and a lot of promises held forth; as yet, lignin is at best a cheap fuel. Yeast for high-protein feeds and CO_2 are possibilities, but not life-savers. But perhaps the major problem: when the Springfield plant operates at capacity, the productive capacity for industrial alcohol on the Pacific Coast will be 300 percent greater than prewar, yet the region's needs have not kept up with the capacity to produce. Thus, the fate of the Springfield plant after a few years will probably depend on profitable outlets for large volumes of lignin and an expanded alcohol market.

NEW MAGNESIUM BLASTING POWDER DEVELOPED

An explosion last month which killed two people and destroyed a building at the Permanente Metals Corp., Permanente, Calif., revealed that this Kaiser subsidiary had been developing a new-type blasting powder based upon magnesium dust. Company officials stated that the new powder had been in successful use for several months in the limestone quarry of Permanente Cement Co. and that it would be more economical to use than existing powders. The explosive is said to be insensitive to shock and to have greater safety potentialities than powders now in use.

Testimony at the coroner's inquest brought out that a spark would not ignite the powder, and that a match would cause ignition but not detonation. A new machine had recently been installed to increase output of the experimental plant, and over 4,000 lb. of the explosive had been produced on the day of the accident. Magnesium dust for the blasting powder, when commercialized, would probably come from the firm's carbothermic process magnesium plant which is scheduled to resume operations within a few months.

WESTERN PHOSPHATE DEPOSITS SURVEYED BY MONSANTO

Phosphate deposits in Montana, Idaho and near Vernal, Utah, were surveyed during the latter part of August by R. R. Cole, Gaston DuBois, and B. G. Klugh, all executives of Monsanto Chemical Co. Also inspected were phosphate deposits near Randolph, Rich County, Utah, 100 miles north of Salt Lake City and potash developments on Bonneville Salt Flats west of Great Salt Lake.

If a satisfactory site for a phosphate reduction plant can be found in the Intermountain area, Monsanto might begin erecting a unit at an early date, stated Mr. Cole, who added that it would probably take five years to get such an elemental phosphorus plant into full-scale production. Site of such a plant would have to be near a railroad and close to large phosphate rock deposits; a unit with a capacity less than 100 tons of elemental phosphorus daily would probably not be feasible, according to estimates.

Industrial engineers believe that the phosphorus industry of the country might gradually shift westward into the area of large rock reserves and cheap power. The Monsanto survey is one of about a half-dozen similar studies made by various firms within the past two years.

TACOMA ALUMINUM PLANT BIDS RECEIVED

Three bids have been received by WAA for operation of the alumina reduction plant at Tacoma, Wash., built during the war at a cost of $6,500,000 and formerly operated for the government by Olin Corp. Permanente Metals Corp. of Cakland, Calif., a Kaiser subsidiary, proposed a 5-year lease at 2 percent of gross sales the first year and an increase of 0.5 percent each succeeding year. Eastern Metal Products Co. of Mount Vernon, N. Y., guaranteed a minimum of $60,000 yearly, to be increased $15,000 more each succeeding year on a 5-year lease, plus 10 percent of gross earnings before taxes. Reynolds Aluminum Co. of Richmond, Va., offered $200,000 the first year and $50,000 each succeeding year. Award of the plant is expected to be announced late this month.

The Tacoma plant, a high-cost producer during the war, had two pot-lines and a designed capacity of 41,500,000 lb. of aluminum yearly. It is now the only aluminum plant in the Northwest not already back in production.

DOW EXPANDS IODINE PRODUCTION CAPACITY

An expansion of about 50 percent in capacity to produce iodine at Seal Beach, Calif., is now under way by Dow Chemical Co., largest domestic producer of this element. At present, Dow has an iodine extraction unit at Venice and a finishing unit at Seal Beach; the increased capacity will result from installation of a second extraction plant near Inglewood. The new unit, consisting largely of storages, treating tanks and absorption towers, is expected to cost over $325,000. Raw mate-

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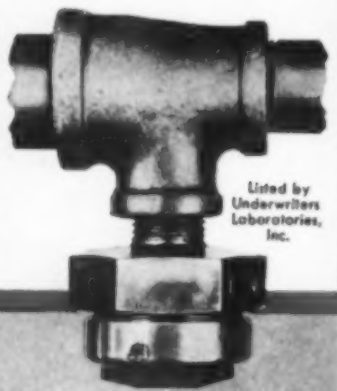

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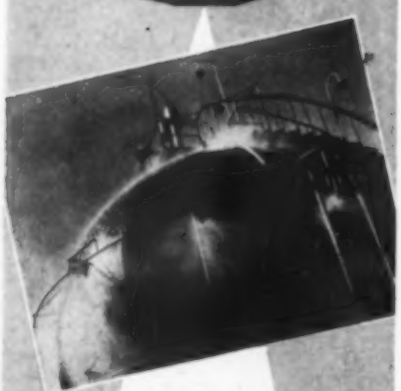

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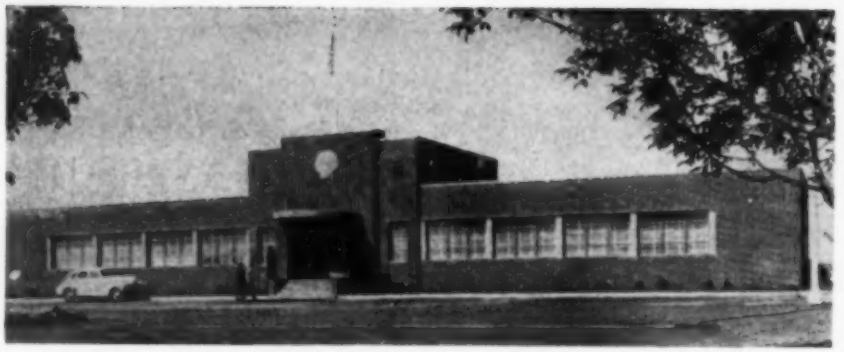

Shell Oil Co.'s new agricultural laboratory which opened last month

rial for the new extraction plant will be waste oil well brines from operations of Standard Oil of California.

All iodine production in this country is in the Long Beach area of California, since certain oil well brines of the region are the only known waters in the United States with sufficient iodine to warrant commercial extraction. In fact, the limiting factor in the expansion of the domestic iodine industry is the availablity of these high-iodine brines. Waters from the Venice fields contain about 120 ppm. of iodide ions; those from Seal Beach contain only about 65 ppm.

Iodide-containing brines, after clarification to remove oil, are acidified to a pH of about 2-3 with a recycle mixture of H_2SO_4 and HCl, thus precipitating $BaSO_4$. The brine is then chlorinated to release I_2 vapors, blown out with air. Treatment with SO_2 forms HI and H_2SO_4 which absorb the I_2 vapors. Further treatment of HI with Cl_2 precipitates I_2 crystals. The final product is crude lump iodine of some 99.9 percent purity. Use of iodine in this country has probably doubled within recent years, primarily because of new industrial uses and larger usage in cattle feeds.

SHELL OPENS AGRICULTURAL RESEARCH LABORATORY

THE NEW agricultural research laboratory and 142-acre experimental farm of Shell Oil Co., Inc., at Salida, near Modesto, Calif., was dedicated on September 12 in the presence of some 450 guests. The new laboratory, on which construction was started September of last year, is the center of the company's agricultural research in the United States. It is the only one of similar size and scope in the West, according to director Dr. Roy Hansberry, and

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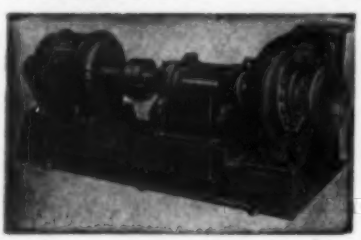

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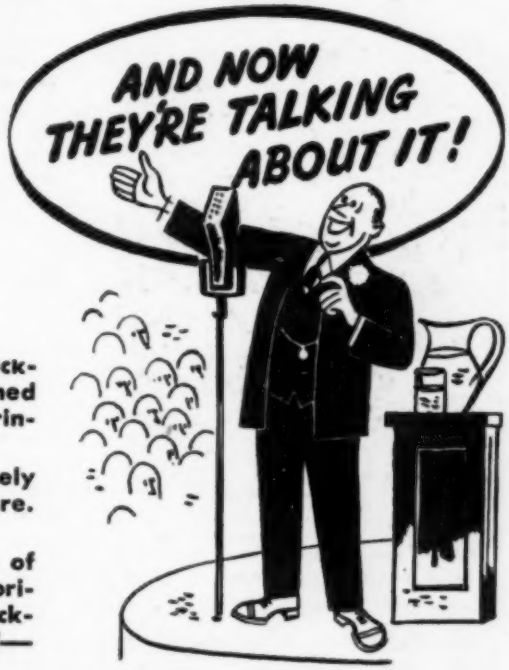

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Palmetto Pyramid is used for reciprocating as well as rotary motion. It is recommended for all types of hydraulic and pneumatic equipment handling hot or cold water, steam, oil, gasoline and most types of solvents and acids.

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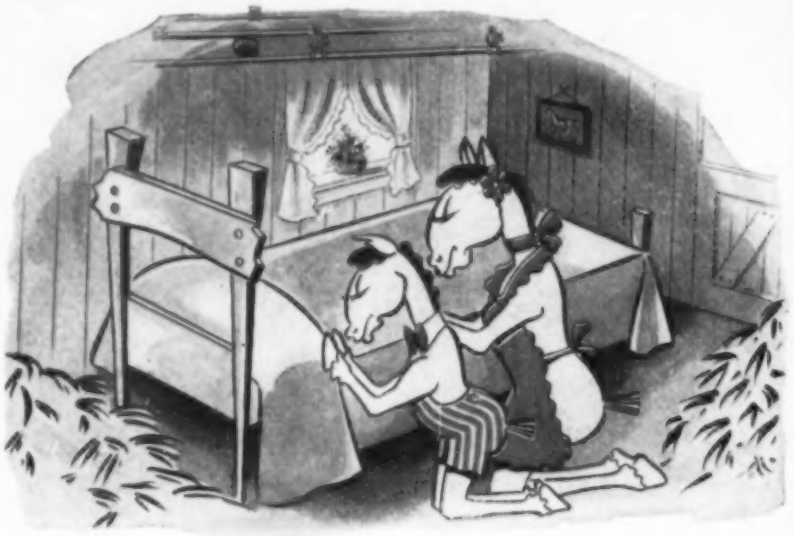

We kneel dear Lord in silent prayer,
Ever mindful of Thy guiding care.
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For the "Automatic" Sprinklers
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Maybe our ode should be entitled "The Horses Entreat" or "The Plugs Plug for "Automatic" Sprinklers."

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is one of the largest commercial laboratories devoted exclusively to broad agricultural research in the entire country.

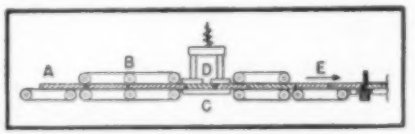
The project cost some $500,000 and has a laboratory staff of 30 entomologists, nematologists, horticulturists, plant physiologists and pathologists, and agricultural engineers; chemical phases of the research projects are conducted at the large Emeryville, Calif., laboratories of Shell Development Co. Some 12-15 ranch workers are employed to operate the 100 acres of trees and vines of all commercial types and the 30 acres of truck crops.

A coordinated activity of Shell Oil Co., Inc., Shell Chemical Corp. and Shell Development Co., the center will work closely with state, federal and university agricultural investigators to develop new ideas, to act as a proving ground for natural and synthetic petroleum-derived products, and to serve as a clearing house of scientific knowledge where specific farming problems may be presented and solved.

ELECTRONIC METHOD DEVELOPED TO EDGE GLUE VENEERS

DISSATISFACTION with the widely-used Miller drum and taping methods of edge-gluing thin veneers has led the Anacortes Veneer Co., at the instigation of research chemist A. C. Carlson, to embark on an electronic edge-gluing research program in cooperation with Dr. O. H. Schrader and David P. Thomas of the University of Washington College of Forestry. As a result of findings to date, Anacortes Veneer Co. is now constructing a combination conveyor and press which will use the Mann-Russell radio-frequency generator and the "parallel bonding" principle devised by these men.

Narrow veneer stock up to 10 ft. long will be stacked and sprayed with a heat-reactive resin adhesive that reacts favorably in the r.f. field. Preliminary work has



Electronic edge-gluing of veneers now in development at the University of Washington and Anacortes Veneer Co.

been with a catalyzed urea-formaldehyde resin, but for waterproof plywood a phenol or resorcinol glue adaptable to r.f. gluing could be used. Curing of the glue is only a matter of a few seconds.

Referring to the accompanying figure, the veneers will be fed onto a lay-up table, *A*, and led into a set of friction conveyor belts, *B*, which will force the veneer through the electrostatic field created by the dead plate *C*, and the electrodes *D*. These will exert vertical spring pressure to hold the veneer edges in horizontal alignment. Upon emerging from the platens, the veneers will be picked up by a set of discharging slip-friction conveyor belts, *E*, driven at a slower speed than the charging belts and exerting less vertical pressure. This will create horizontal pressure on the glue joint in the r.f. field and bring the edges into accurate register. Electrodes are placed a few inches apart at a 20 deg.

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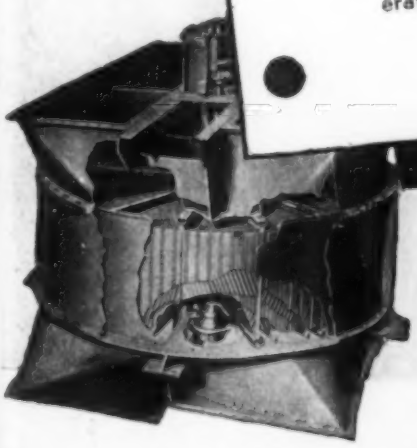

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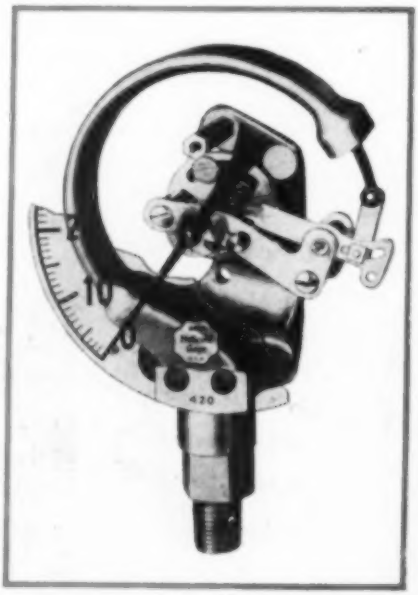
That isn't hearsay or guesswork. It's a fact proved over and over again by many companies who have made Helicoid Gages their standard.



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angle to the conveyor system and the dead plate is directly below the electrodes. The glue line passes progressively through the r.f. field and the "parallel bonding" feature is realized as the r.f. energy is concentrated through the glue line between the alternating positive and negative plates. Electrodes and dead plate are made of corrugated aluminum thus aiding mechanical solution of the problem, which eliminates sticky platens caused by deposits of squeeze-out glue.

The new electronic system should eliminate the 3-4 percent veneer waste where taping is now practiced. As for speed, the researchers feel that the method will outstrip the Miller drum process and eventually reach an output of 40-50 ft. per min. or more. Cost of installation should not be more than present methods, and the greater operating economy of the electronic process should make it commercially attractive. The researchers intend to try gluing very narrow widths in a commercial press to determine feasibility of using waste material for core stock. If such a system proves practical, up to 10 percent saving in wood might be realized in a plant using this process. If the installation at Anacortes Veneer Co. confirms the present impression of technical and economic feasibility, the process would probably be installed by all the major Northwest softwood plywood mills and would become a major wood conservation measure in the Douglas fir plywood field.

NEW HYDROCARBON SEPARATION PROCESS DEVELOPED

After several years of research and pilot plant work, a new method known as the Hypersorption process has been developed by Union Oil Co. of California for the commercial separation of hydrogen and light hydrocarbons. Essentially, the process depends on the ability of activated carbon to adsorb heavy hydrocarbons to a greater degree than those of smaller molecular weight. Originally conceived as a means of purifying butadiene from cracking operations, interest at the present time is centered on the adaptability of the Hypersorption process to provide cheap ethylene gas and hydrogen from gaseous hydrocarbon mixtures. Although no full-scale plant using the new process is yet in commercial operation, one such unit is now under construction and several others are in the design stage. Design data are based upon results obtained from the large pilot plant which has been in operation for some time by Union Oil Co. at its Wilmington, Calif., laboratories under the direction of D. E. Carr, manager of research. Other than the advantage of low capital investment, the process is believed capable of purifying ethylene and hydrogen at an unusually low operating cost.

Among applications of the process are those for separation of methane from hydrogen in hydrogenation and hydroforming plants and for the separation in a single unit of ethane and ethylene from methane, hydrogen and the heavier constituents of gas streams in ethylene plants.

The Hypersorption column, which is filled with granular charcoal, has three major functions—cooling at the top, adsorption and rectification in the middle, and steam stripping at the bottom. Feed gas passes upward

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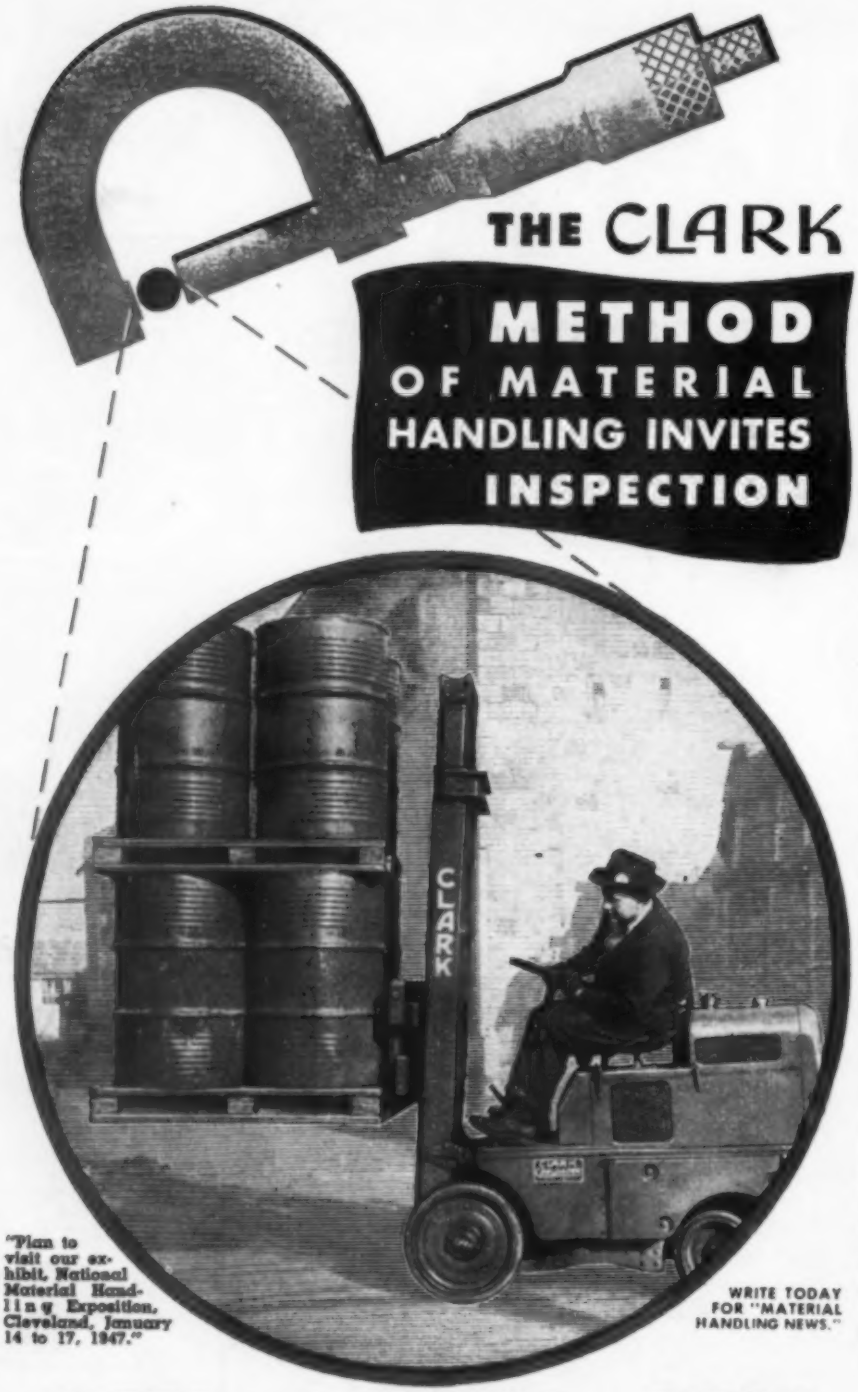

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countercurrent to a moving bed of activated charcoal, and in so doing the heavier compounds are adsorbed on the charcoal. The light products disengage and pass off through a cyclone. Charcoal passes downward below the feed point and contacts a reflux of heavy constituents from the stripper which liberates lighter adsorbed constituents. A sidecut between the feed and bottom product gas disengaging section takes off these intermediate products. As the charcoal flows downward it meets an upward flow of steam which liberates the heavier hydrocarbons; these serve as reflux and then pass out as bottoms product.

The charcoal subsequently flows into the direct-fired stripping section and passes through tubes heated by circulating hot flue gases and through which steam is passed in countercurrent flow. Residual hydrocarbons are removed in this zone. A charcoal regeneration unit is provided to act in parallel with the Hypersorption tower, reactivating the charcoal by high-temperature steam treatment. After regeneration, the charcoal passes through the cooling section at the top of the Hypersorber; this consists essentially of a tube-and-shell exchanger wherein the adsorbent is cooled to atmospheric temperature. It then travels downward through the tower as previously described.

NEW PHOSPHATE MINE OPENED BY SIMPLOT

ANOTHER step in the expansion of the J. R. Simplot superphosphate plant at Pocatello, Idaho, was taken during June with the official opening of the new company mine 19 mi. east of Fort Hall, from which over 10,000 tons of phosphate rock has now been hauled. Although still in the experimental stage, the Fort Hall mine is expected to develop into a source of 72 percent rock much closer to the fertilizer plant than the Montpelier and Conda mines, from which all rock has been shipped in the past. Diamond drilling is being conducted in other areas in the vicinity.

The superphosphate plant at Pocatello recently bought by Simplot (*Chem. & Met.*, May, p. 198) is also undergoing expansion, according to E. W. Hansen of Simplot Fertilizer Sales Co., who stated that by July 1947 the plant is expected to be operating at the annual rate of 200,000 tons of superphosphate. The 1946 output, expected to approximate 90,000 tons, has been greatly reduced by strikes, particularly that at the Garfield sulphuric acid plant. Now that the Utah smelter is operating again, fertilizer output should quickly climb to the capacity of 150,000 tons annually. A third new Raymond rock pulverizing machine is being added to the Simplot plant, having a 16-ton hourly capacity. A second acidulation unit is also being installed.

PABCO TO BUILD ASBESTOS PRODUCTS UNIT

FOR the first time in the West, asbestos cement siding shingles, asbestos roof shingles, corrugated siding and asbestos lumber or flat board will be produced in a new $1,000,000 plant to be erected by The Paraffine Companies, Inc., San Francisco, at Redwood City, Calif. The factory will be built by Plant Rubber & Asbestos Works, a wholly-owned subsidiary, adjacent to this

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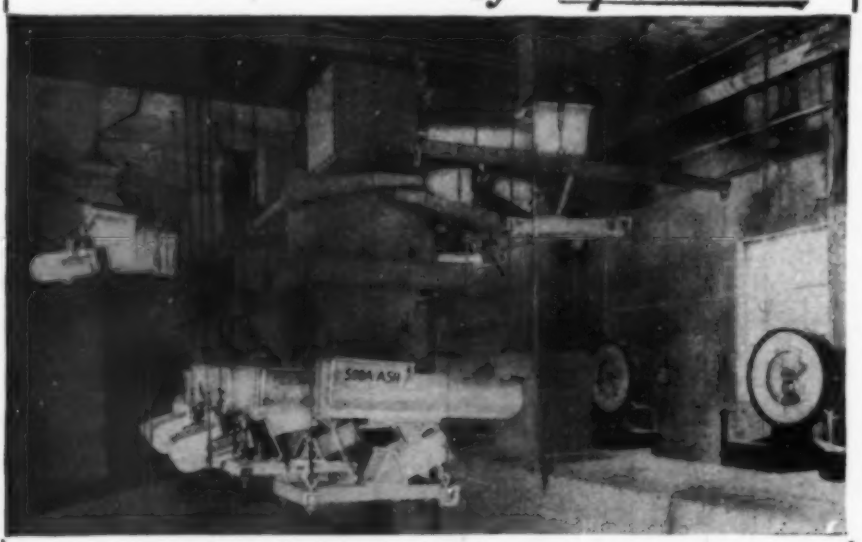

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SIMPLE CONTROL
SELECTIVITY

SYNTRON Vibratory Feeders inter-locked with scale control permit the handling of any one, or a combination of any number of materials to be accurately and automatically batched at the same time.

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firm's plant where magnesia insulation products are now made. Construction, already approved by CPA will begin immediately. Redwood City was chosen as the site of the expansion because of the existing Plant Rubber unit with its specialized facilities and technicians and the availability of the basic raw materials including seawater bittern and salt. Early this spring, Pabco started a $6,000,000 expansion of its Emeryville linoleum floor coverings, paint, roofing and building materials factory and of its research and development laboratory (*Chem. & Met.*, Jan. 1946, p. 178).

GR-S OUTPUT INCREASED BY LOS ANGELES UNIT

Production schedules for GR-S rubber at the Torrance, Calif., plant operated for Rubber Reserve by Goodyear Synthetic Rubber Corp. have been increased from 3,000 to 4,250 long tons monthly, starting in July. Production quotas will probably remain near this figure until the serious rubber shortage is partly alleviated. To meet the demand for increased butadiene production in southern California, pipelines are being installed to allow a "tandem" operating arrangement between the butadiene units of Standard Oil of Calif. at El Segundo and those of Shell Chemical Corp. at Torrance. Increased production of GR-S at Los Angeles does not add to the country's total rubber output, but means that it is somewhat more economical to convert local butadiene into copolymer at Los Angeles than to ship it east for conversion and redistribution to eastern rubber consuming centers.

A total of about 600,000-650,000 long tons of GR-S is expected to be made this year, while imports of natural rubber will probably approach 300,000 tons, mostly from Malaya. Price of GR-S continues at 18.5c. per lb. while crude natural rubber recently increased to 23.5c. It has been estimated that synthetic rubber can be made and sold under normal business conditions for about 15c. per lb. Keen competition between the natural and synthetic products will not develop until supplies of natural rubber are again plentiful.

WASHINGTON-OREGON AIChE SECTION ORGANIZED

Becoming the third section in the West, the Washington-Oregon chapter of the American Institute of Chemical Engineers was officially approved by the Institute Council in July of this year. Organization of the section was undertaken in November 1944 through the preliminary formation of the Chemical Engineering Society of Washington, with some 34 members of the AIChE enrolled as active members of the Society. In January 1945 a constitution and bylaws were adopted. Dr. H. K. Benson of the University of Washington, Seattle, was elected chairman. The Society at once entered into active participation in the Puget Sound Council of Engineering and Technical Societies. Three technical meetings were held during 1945, and the paid-up membership of 22 doubled during the year.

In February of this year it was suggested that the members of the Institute

GEIGER COUNTER SPECTROMETER

The Norelco Geiger counter X-ray Spectrometer makes use of a Geiger counter tube by means of which intensities and space distribution of X-ray reflections are easily and quickly determined.

Through the use of electronic circuits, characteristic reflections are registered directly on a scaled chart—showing at a glance, line positions and intensities.

This method, besides being accurate, saves considerable time in process work where continuous control is necessary and results must be obtained as rapidly as possible. The apparatus does not require constant attention. Relatively unskilled operators can perform routine tests.

Time consumed in photographic processing and the possibility of human error in intensity evaluation are eliminated

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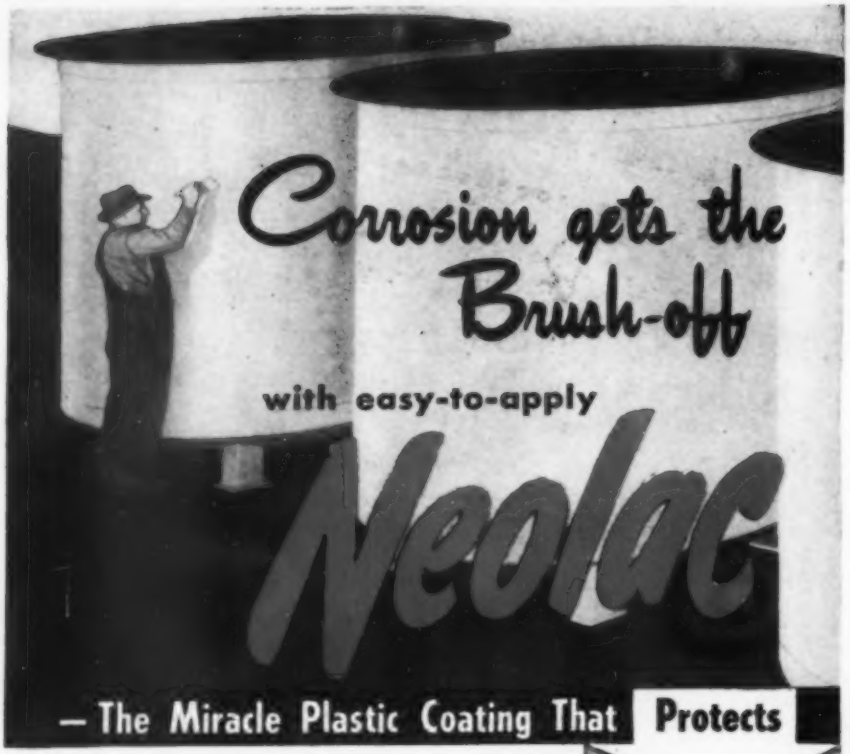

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in Oregon should be included. These members consented unanimously, and in July the Chemical Engineering Society of Washington officially became the Washington-Oregon section of the AIChE. The potential membership approximates 100 and average attendance for the first four meetings during 1946 has been 59. It is planned to hold at least one meeting each year in Oregon as well as in other points of special interest to chemical industry.

Officers for the new section will be Gerald Alcorn of Weyerhaeuser Timber Co., Everett, as chairman; Roger E. Chase of R. E. Chase & Co., Tacoma, as vice-chairman; and R. W. Moulton of the University of Washington, Seattle, as secretary-treasurer. The executive committee consists of H. K. Benson, John M. Kniseley of Laucks Laboratories, Inc., R. E. Chase, R. W. Moulton, and Gerald Alcorn.

NEW INSULATION PLANTS TO USE CHEMICAL TREATMENT

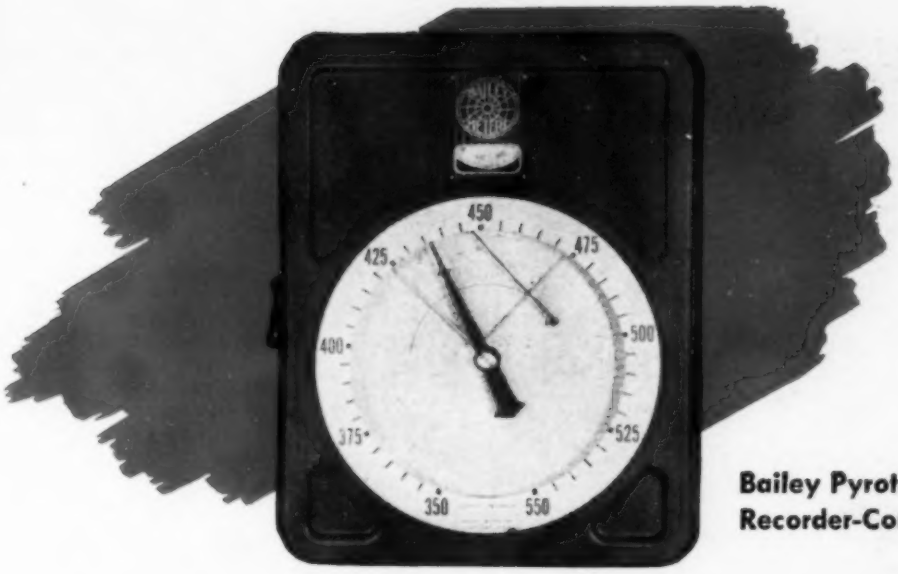
A NEW $60,000 insulation plant has just been established at Fresno, Calif., by National Insul-Fluf, Inc., recently incorporated in the state of Kansas. The insulating material is a fibrous cellular product made by rendering newsprint back to the pulp state and then treating with chemicals to impart resistance to fire, water, rodents and insects. The Fresno plant, with a staff of 35 persons, has now reached full operation and uses a carload of treating chemicals monthly, it was stated. Plans are now under way for establishing four additional factories on the Pacific Coast within the next 18 months. Edgar L. Harris is president of the firm, with headquarters at Fresno.

URANIUM WATER BOILER HAS UNIQUE FEATURES

A UNIQUE type atomic chain reactor or "water boiler" that uses uranium which has a much higher concentration of U-235 than is used in wartime chain reactors has been developed by scientists in the University of California Los Alamos Scientific Laboratory, according to a recent announcement. Another unique feature of the "boiler," states Dr. L. D. P. King who is in charge of the work, is its small size. While the instrument is not directly applicable for power production in the sense of driving a generator or heating a house, modified forms designed for such power production may be developed in the near future. It is similar in principle to the large "piles" or neutron reactors built during the war for production of plutonium.

ZIRCONIUM PILOT PLANT TO OPERATE SOON

EQUIPMENT is being assembled for the pilot plant to demonstrate the new method of producing zirconium metal developed by the Northwest Electrodevelopment Laboratory of the U. S. Bureau of Mines at Albany, Ore., and the unit is expected to be in operations soon. The process consists of converting zircon to zirconium chloride, reduction of the chloride to zirconium metal with magnesium, and melting of the metal to ingots in specially designed vacuum furnaces. Raw material will be the 28 percent ZrO_2 concentrates ac-



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Looking for Better Temperature Instruments?

. . . Then check these features of Pyrotron Electronic Resistance Thermometers . . .

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Bailey Pyrotron Resistance Elements are made of highest purity platinum—the material used by the Bureau of Standards in establishing basic standards for temperatures from —190°C to +660°C.

THREE TYPES OF CONTROL

Pyrotron Controllers may operate: on-off electrical systems by either electronic relays or electric contacts, modulated electronic systems, or air-operated systems. Two temperatures may be recorded on the same chart and controlled by a single instrument.

FACTS PUT INTO USABLE FORM

Bailey Pyrotrons may be arranged to put temperature facts into convenient usable forms. If two or more temperatures are related, they may be recorded as continuous records on the same chart for easy comparison. The average of several temperatures or the difference between two temperatures may be recorded as a single continuous record which may be retransmitted to a distant point or used to actuate a control system.

EASY INSTALLATION

Bailey Pyrotrons do not require careful leveling or protection against vibration. Three ordinary copper wires are all that is needed to connect each temperature sensitive element with the recorder. Power may be taken from any 115 volt 60 cycle circuit.

MINIMUM MAINTENANCE

The absence of galvanometers, batteries and standardizing equipment, together with the use of interchangeable unit assemblies, reduces Pyrotron maintenance to the vanishing point.

ABUNDANT POWER

A separate motor drive for each temperature furnishes abundant power to operate a recording pen, a controller and an alarm switch.

For the full story on this unusual electronic resistance thermometer which is suitable for ranges between —100°F and 1200°F, ask for Bulletin No. 230-A. P-9

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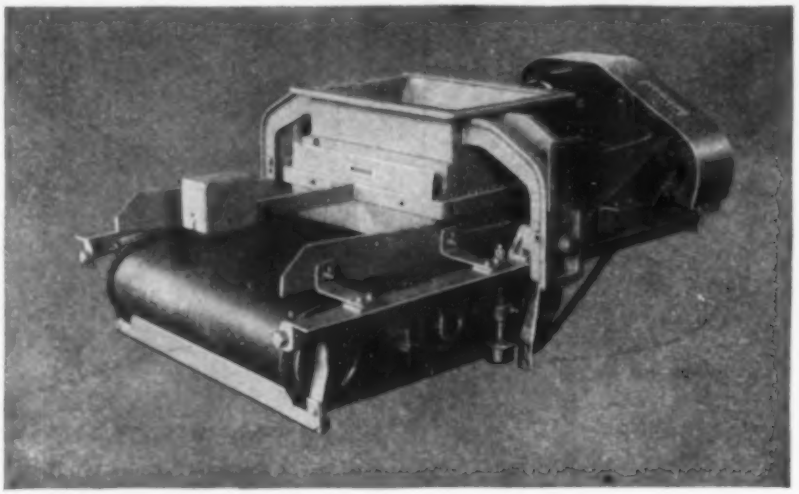

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HARDINGE Constant-Weight FEEDER

This Feeder is revolutionary in principle, because it regulates both coarse and fine materials by *weight* instead of volume. Furthermore, it *automatically* maintains a constant weight of material no matter how other conditions change.

Other types of regulating feeders measure by volume rather than weight, and thus are subject to size of the feed, bin segregation, bulking, moisture, and specific gravity of materials.

This variation is at least 10%, and sometimes as much as 40%, even with apparently uniform materials. The Hardinge *Constant-Weight* Feeder eliminates these variations, assures uniform operation, and provides a record of the amount fed that can be relied upon.

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cumulated by two firms operating during the war to recover chromite from Coos Bay, Ore., beach sands. Several thousand tons of high-zirconium concentrates are available. Use of zirconium metal is limited because of its high price—now about $500 per lb. It is hoped that the pilot plant operations at Albany will demonstrate the technical and economic feasibility of the simplified process worked out at the Laboratory.

The Northwest Electrodevelopment Laboratory was established by Congress to conduct research on methods that might stimulate use of Bonneville power and Northwest mineral resources. The Albany site and building were acquired in 1943; experimental work got under way in late 1944. The laboratory is now reaching full operation. Other projects include the treatment of lead-zinc ores, manufacture of nickel- or chrome-steel from Cle Elum ores, treatment of high-phosphorus Scappoose iron ores, production of vitreous silica from quartz sands carbothermic reduction of magnesia and development of vacuum metallurgical techniques. The laboratory is under the supervision of Dr. B. A. Rogers.

NEW TYPE LIME KILN INSTALLED IN UTAH

WHAT is probably the newest type of kiln for producing lime has been operating for almost a year so satisfactorily at the Provo Lime Co., Provo, Utah, that two additional units will be installed at this plant in the near future, according to reports. The new type kiln, known as the Nelson inclined furnace number 5, was developed by Victor J. Nelson Engineering & Construction Co., Burbank, Calif. Although the Provo installation is the first of its kind in this country, two earlier installations were made in Mexico.

The Provo furnace was installed at a 35-deg. slope and firing is done by two small oil burners located at the lower or discharge end. Waste heat is returned through special chambers so as to be fully utilized, and stack gases are reduced to about 250 deg. F. Air for combustion passes over the hot discharge to cool the lime and also to be preheated. The furnace is said to operate efficiently up to 3,400 deg. F. The only power required is that for a 1-hp. motor driving an exhaust fan and for a small variable-speed motor operating the discharger and regulating the rate of discharge. A system of stoker rods, which can easily be replaced, maintains uniform flow of material through the kiln. Because of the air-tight burning chamber, the furnace can be adapted to the recovery of CO_2.

Capacity of the Nelson furnace at Provo Lime Co. is reported to be 12-15 tons of finished lime per 24 hr. Fuel consumption for the burners is at the rate of about 21 gal. of cheap fuel oil per ton of completely burned lime. This has been reported to be less than half the calcination cost in the old-type coke-burning shaft kilns. Only one man is needed to operate the furnace.

HOOKER BUYS CATALYST PLANT IN TACOMA

SALE of the DPC aluminum chloride plant in Tacoma, Wash., has been announced by WAA to Hooker Electro-

General Chemical Fluorine Research Announces

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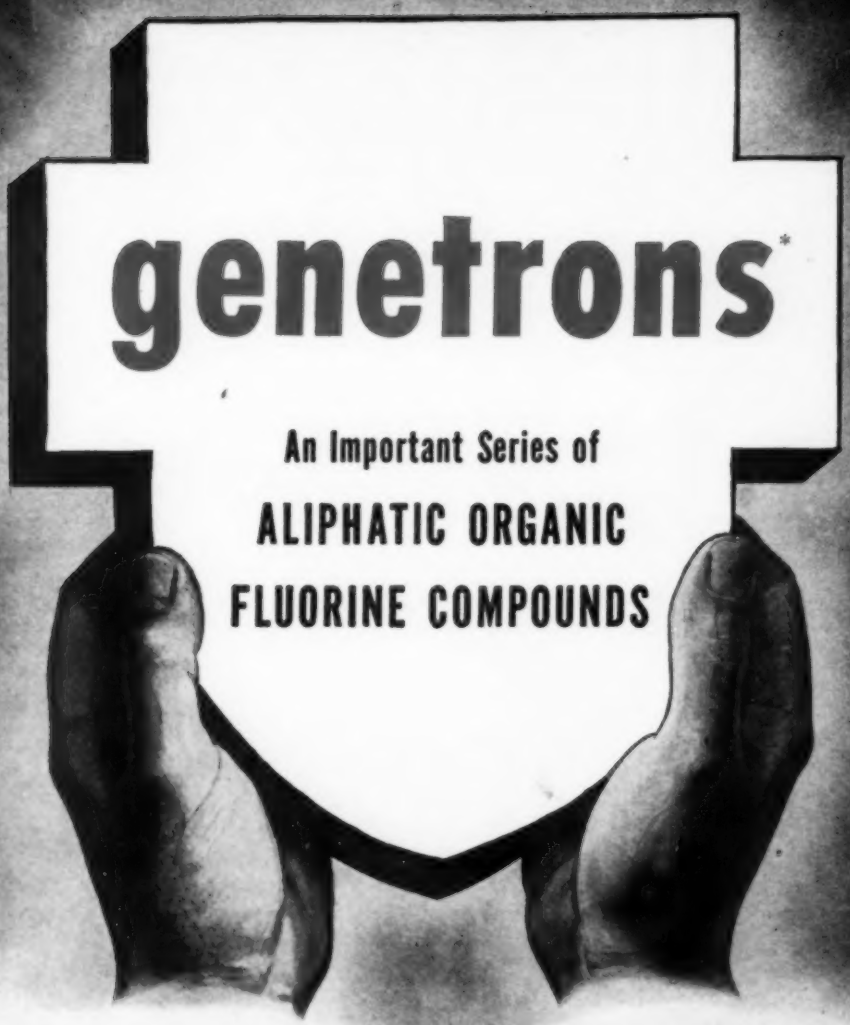
An Important Series of

ALIPHATIC ORGANIC

FLUORINE COMPOUNDS



The Genetrons . . . another major contribution by General Chemical Fluorine Research to Basic Chemicals for American Industry.

So varying are the properties of the *Genetrons* that they merit investigation in many fields—perhaps your own—as aerosol dispersants, refrigerants, dielectrics and organic solvents, and as intermediates in the manufacture of mixed olefinic halide monomers.

The individual *Genetron* products are soon to be announced; for immediate information, contact

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Any size, any shape can be made to specification in Littleford's modern plants. Whether Plain Steel, Stainless, Stainless Clad, Monel, Inconel or Herculoy is needed, the same precision and skill is utilized to make a perfect product. If it's an Agitator Tank, Pressure Tank or a Plain Tank, it can be fabricated at low cost, because Littleford has 65 years experience in Tank Construction. Send blue prints today for an estimate.

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An explosion left little at this plant of Aerojet Engineering Corp.

chemical Co., by whom the plant had been operated. The government factory, located on a 0.6-acre leased tract, was designed to produce 225 tons monthly of anhydrous aluminum chloride. The product was largely used as a catalyst in petroleum refining processes, such as pentane isomerization and vapor-phase isomerization of n-butane to isobutane. Process equipment included two chlorine evaporators, 12 sheet steel $AlCl_3$ condensers, 12 reactors with crucibles, screening equipment and low-pressure air blowers. Other products of Hooker Electrochemical Co. at Tacoma include caustic soda, chlorine, HCl, hydrogen and, with Hooker-Detrex Corp., trichlorethylene.

JET FUEL EXPLOSION DEMOLISHES AEROJET

AN EXPLOSION that was heard and felt five miles away completely demolished a two-story, 60 x 130 ft. brick building and claimed eight lives August 21 at the Aerojet Engineering Corp. plant in Azusa, Calif. In addition, more than a score of other workmen were injured by flying fragments. The disaster occurred in the mixing plant where fuels for jet units are prepared. Apparently a fire that had broken out about 30 min. before the blast was successful in reaching a storage of explosive chemical now believed to be potassium perchlorate instead of nitromethane as assumed earlier. The firm, a subsidiary of General Tire & Rubber Co. of Akron, Ohio, had an excellent safety record throughout the war.

MONTROSE TO MAKE DDT IN CALIFORNIA

A NEW plant for the manufacture of technical DDT for use by West Coast producers of insecticides will soon be going up in Los Angeles, according to a recent announcement by P. Rothberg, president

LIQUIDATE *Your* DUST AND FUMES!

We do mean "liquidate" in the sense of finality, and we also refer to Schneible wet method for eliminating contaminated air.

For the removal and disposal of dust, fumes and odors, there is nothing to equal the Schneible wet method for thoroughness, dependability and ultimate economy.

Multi-Wash Collectors use water (or other liquid) to wash contamination from the collected air. The separated solids, as sludge, flow to a dewatering tank—or waste. The sludge is easily disposed of, and the cleared water is re-circulated. Used in leading processing plants.

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LIQUID-VAPOR INTIMATE CONTACT EQUIPMENT for DUST COLLECTION ABSORPTION CONDENSATION AND TEMPERATURE REDUCTION

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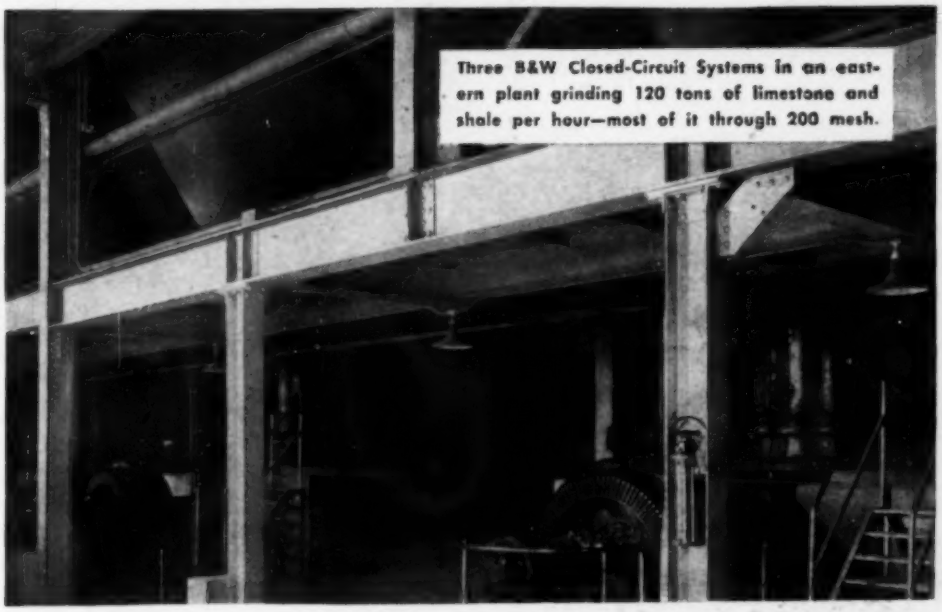
the cost-saving features of the



Three B&W Closed-Circuit Systems in an eastern plant grinding 120 tons of limestone and shale per hour—most of it through 200 mesh.

B&W CLOSED-CIRCUIT SYSTEM

Limestone, shale and other raw materials are ground *and* dried automatically and simultaneously *within* the B&W Closed-Circuit System. No separate drying equipment is needed.

Low fuel costs. With the B&W System, fuel consumption for heating drying air is much less than with other methods—as little as 0.3 gal. of oil per ton of material ground.

Gravity discharge in B&W System eliminates sweep. Material from grinding zone is discharged by its own weight. Output is noticeably stepped up, maintenance cut down.

A thoroughly mixed product is assured through substantial circulating load.

The B&W Pulverizer—heart of the B&W Closed-Circuit System—is available in sizes suitable to all capacity requirements.

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Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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Solvay Products for Soap Manufacturers

Calcium Chloride
Caustic Potash
Caustic Soda
Potassium Carbonate
Soda Ash

SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by The Solvay Process Company

40 RECTOR STREET, NEW YORK 6, N. Y.

of Montrose Chemical Co. of Newark, N. J. The new affiliate will be known as Montrose Chemical Corp. of California. Steps have already been taken to acquire a suitable plant and equipment. For the present, entire capacity of the unit will be devoted to production of technical DDT. A survey of the western area by Montrose Chemical Co. showed a widespread use of DDT insecticides in agriculture, but that there was no producer of this basic chemical in the entire West. It was to correct this unbalanced condition that prompted Montrose to begin operations in California. The firm is already a producer of tricresyl phosphate, crystalline ergosterol and other synthetic organic chemicals.

WEST'S PROCESS INDUSTRIES CONTINUE EXPANSIONS

Phosphoric Acid—Anaconda Copper Mining Co., Anaconda, Mont., has announced intentions to build a $1,069,000 phosphoric acid plant at Anaconda. The plant now produces wet process H_3PO_4, chamber H_2SO_4 and superphosphate.

Insulation—Pacific Rockwool Co. has begun construction of a $100,000 insulation plant near Dishman, Wash., to produce 20,000 tons of insulation annually. Production is expected to start next spring.

Insecticides—California Spray Chemical Corp., Richmond, Calif., has purchased a plant in Fresno for approximately $125,000 to be used as a warehouse and manufacturing unit to serve the San Joaquin valley. About $25,000 worth of new dust mill equipment will be installed.

Selenium Cells—Selenium Corp. of America, Los Angeles, proposes to build a new factory at El Segundo, to cost about $200,000. The firm is a producer of selenium photo-cells and similar scientific equipment.

Natural Gasoline—Survey for feasibility of a proposed $3,500,000 natural gasoline plant in the booming Rangeley, Colo., oil field is being conducted by Stearns-Rogers Mfg. Co., Denver. At present, there is no refinery of any type in the Rangeley field.

Beet Sugar—Canadian Sugar Factories, Raymond, Alberta, has awarded contract for a new $2,250,000 beet sugar mill at Taber to Dominion Construction Co., Ltd., Vancouver, B. C. The firm now has two beet sugar refineries located at Raymond and Picture Butte, Alberta, having a total capacity of 2,900 tons of beets daily.

Containers—A $600,000 fiberboard products factory will probably be built soon in Alameda, Calif., by Kieckhefer Container Co. of San Francisco.

Batteries—Contract has been awarded by Willard Storage Battery Co., Cleveland, Ohio, for a one-story, 150 x 360 ft. storage battery factory at Portland, Ore., to cost approximately $500,000 for plant and equipment to produce electric storage batteries. Construction will start immediately. Cascades Plywood Corp. has already under construction a $300,000 battery separator plant in Oregon (*Chem. & Met.*, May 1946, p. 200).

Containers—Fiberboard Products, Inc., a subsidiary of Crown Zellerbach Corp., San Francisco, has purchased 4.5 acres in Portland and intends to erect a new 200 x 659 ft. factory at a cost of about $1,000,000 including equipment to produce a complete line of cartons and paper boxes used in packing and shipping every type of commodity produced on the Pacific Coast.

Pulp and Paper—Contracts for additions to the pulp and paper plant of Crown Zellerbach Corp. at Camas, Wash., has been awarded to the Austin Co., Cleveland, at a cost estimated at $3,756,000.

Plywood—A new firm, Humboldt Plywood

Want TO SPEED UP 3 WAY CONTINUOUS SEPARATION?

Use the De Laval "Nozzle-matic"

THE DE LAVAL "Nozzle-Matic" is constantly showing the way to new successful applications of centrifugal force as a means of effecting continuous 3-way separation. Separation...concentration... clarification are all being done faster, and better, with this machine.

The capacity range of the De Laval "Nozzle-Matic" is wide—from 400 to 6,000 or even more gallons per hour, depending on the nature of the liquids being separated and the amount of solid impurities present in them. Within that very broad range the "Nozzle-Matic" will continuously separate and discharge two liquids of different specific gravities, and simultaneously remove and continuously discharge impurities.

Processes calling for simple two-way separation, clarification or concentration, can also be handled more efficiently on a continuous basis by De Laval centrifugal machines.

The "Nozzle-Matic" is available in several modifications, to enable processing a wide variety of materials, ranging from fish oil to yeast.

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MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

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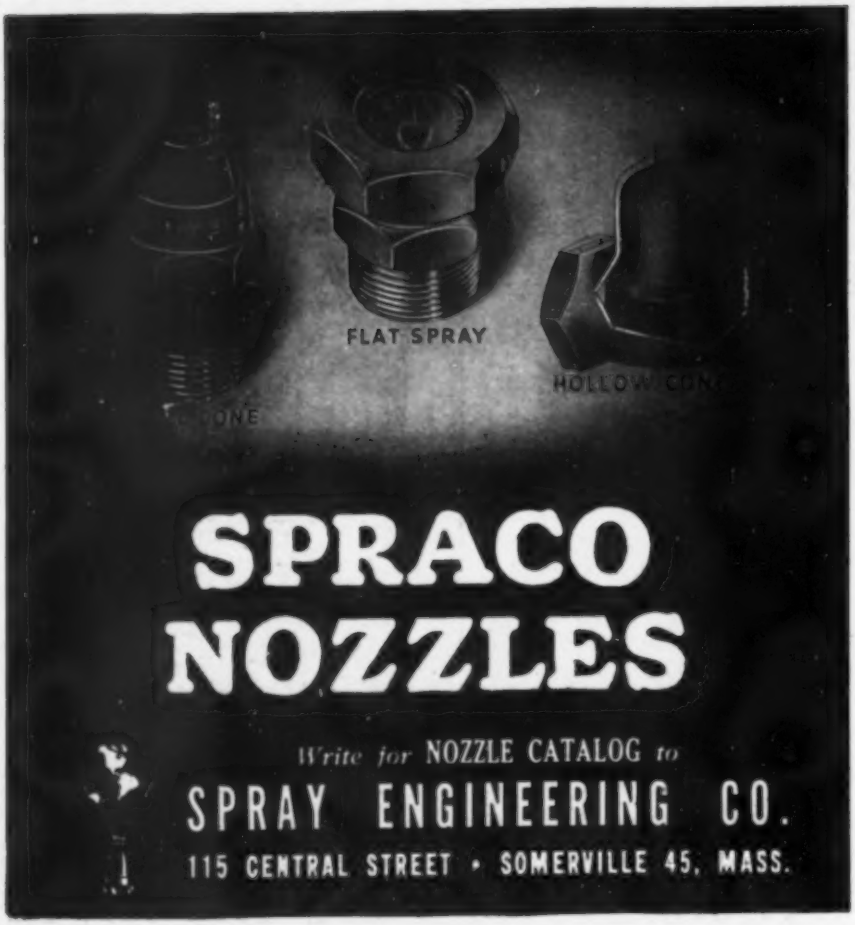
for SEPARATION—CLARIFICATION—CONCENTRATION



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Corp. of Arcata, Calif., plans to build a $1,000,000 Douglas fir plywood plant, consisting of three buildings, at Arcata.

Paints—Space has been leased by Hart-Burns, Inc., of Dallas, Tex., for a pilot plant at Riverside, Calif., for manufacture of architectural and marine paints. A paint research laboratory is already in operation. The firm plans to build a new paint factory as soon as materials are available.

Bentonite—Construction of a new plant in Greybull, Wyo., for processing of bentonite will be begun shortly by Douglas Sulphur Co., Houston, Tex., according to a recent report. The plant will probably have an output of 100 tons daily from a deposit estimated at 7-10 million tons.

Catalysts—Filtrol Corp., Los Angeles, is building an addition to its present plant in Los Angeles at an estimated cost of $78,000. The firm produces activated clays for catalyst purposes and adsorbent filtering materials.

Distillery—Schenley Distilleries, Inc., has obtained CPA approval for immediate construction of a distillery and bottling plant at Phoenix, Ariz., at an estimated cost of $1,000,000. The plant will use about 20,000,000 lb. of sorghum grain annually.

Glass—Maywood Glass Co., a subsidiary of Anchor Hocking Glass Co. of Lancaster, Ohio, has purchased an 8.3-acre tract south of San Jose, Calif., to erect a $1,000,000 plant for producing glass jars and bottles for the Pacific Coast. The unit will have about 500 employees. Maywood now has a glass and closure manufacturing plant in Los Angeles.

Aluminum Smelter—Idaho Smelting & Refining Co. will operate in Seattle a portable smelter, mounted on a 4-car railroad train, to process and melt into ingots large quantities of aluminum aircraft scrap from the Sand Point Naval Air Station.

Sulphur—The Leviathan sulphur mine near Leevining, Mono County, Calif., owned by Texas Gulf Sulphur Co., will erect a pilot plant refining unit, according to one report. Little or no native sulphur is now produced in California.

Glass—Ground has been broken for the new $3,500,000 plant of Ball Bros., Muncie, Ind., at El Monte, Calif., and the first unit is expected to operate in November. The plant will make jars and other types of glass and fiber containers.

Research Laboratory—Stauffer Chemical Co., San Francisco, plans to erect a $100,000 agricultural and research laboratory at Mountain View, Santa Clara County, Calif.

Paper Bags—Bemis Bros. Bag Co. plans to expand its present facilities for making heavy-duty bags at Wilmington, Calif., by a $400,000 plant addition. Firm also has a multiwall paper bag manufacturing unit at St. Helens, Ore.

Specialty Papers—Fernstrom Paper Mills, Pomona, Calif., will double its production capacity by adding a $350,000 building and new equipment costing $900,000. The firm makes fruit wrapping, tissue and waxed paper and will add semi-crepe napkin and other specialty paper.

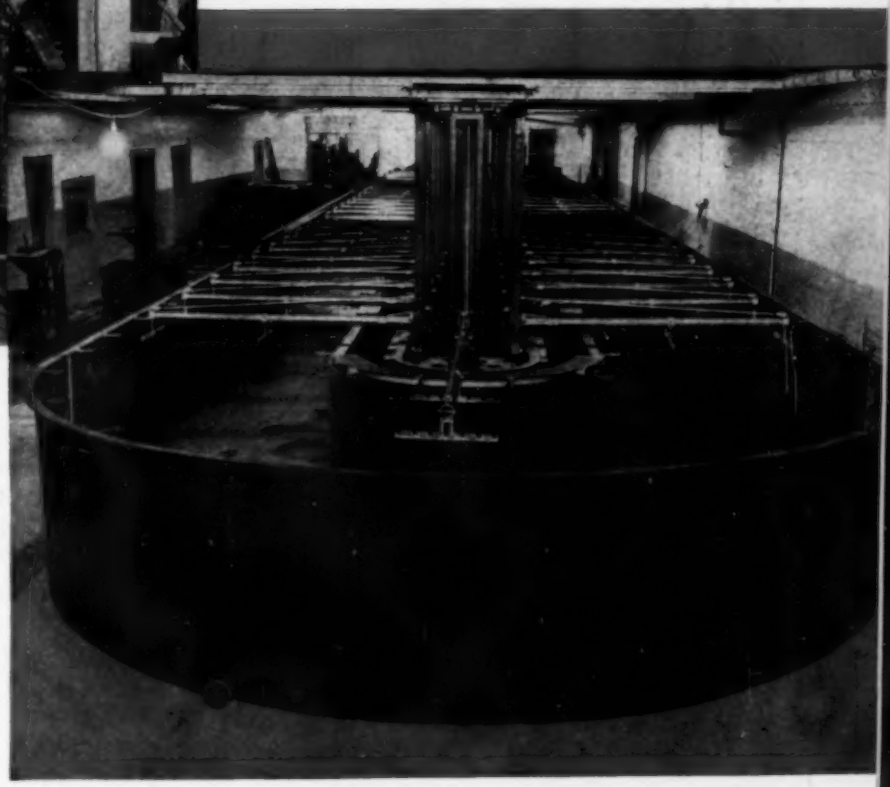
Aluminum—Operations at the former government-owned aluminum extrusion plant at Phoenix, Ariz., will soon be started by Reynolds Metals Co. Top production schedules at the $33,700,000 plant will probably be met early next year. The unit was built in 1943 to produce extruded aluminum shapes and tube blooms.

Process Laboratory—Standard Oil of California has announced award of a $732,400 bid for construction of a process laboratory at the Richmond, Calif., location of California Research Corp. Work will begin immediately. Construction will be part of the $10,000,000 replacement, improvement and new construction program announced early this year for California Research Corp. and for the firm's Richmond refinery.

Maximum Facilities in MANHATTAN'S RUBBER LINING DEPARTMENTS

GIANT OF VULCANIZERS

Largest of Manhattan's extensive battery of rubber lining vulcanizers, this giant, 15 ft. in diameter, will handle any piece of equipment that can be shipped by rail, making possible a complete service in this field and enabling Manhattan to take care of the increasing needs of industry for large equipment. Vulcanizer is shown loaded with 2 huge rubber-lined tanks and 3 big rubber-covered castings.



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Required 7 railroad flat cars to ship. Big in every dimension —length, breadth and width—it was easily accommodated by Manhattan's spacious facilities.

Photo courtesy Hanson-Van Winkle-Munning Company

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Doing the "impossible" has been the record of Manhattan's rubber lining departments for many years. Countless specifications for unusual sizes and shapes of process handling and storing equipment have been met by Manhattan engineers backed by a technique that has steadily developed for 40 years.

Inseparable Bond Developed

During this period, a special process of rubber lining has been developed that places Manhattan Acid-Proof Rubber Linings foremost in the field. Adhesion to metal has been attained so that mechanical separation cannot be effected.

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Compounded to give and take with the expansion and contraction of metal, Manhattan rubber linings can undergo extreme temperature changes without cracking or oxidizing. Other qualities inherent in Manhattan lining compounds are utmost resistance to abrasion, to damage by electrolysis, and to corrosion and contamination.

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Consult Manhattan's engineers about rubber lining and rubber covering possibilities in your plant.

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The Zenith Pulp Press, with capacity up to 26 tons per hour, thoroughly dewaters wet pulps and slurries such as:

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Heavy screw-type spindle applies smooth, continuous pressure, forces pulp or slurry against selective resistance. Rifle drilled resistors permit use of steam when necessary. Minutely perforated screens assure efficient drainage, hold pulp losses to minimum. Ball thrust bearings and oversize shaft bearings reduce power load.

New uses for the remarkably efficient, profitable Zenith Pulp Press are being constantly developed. An experimental press is available for trial in your plant.

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NEWS FROM ABROAD

INCREASED EXPORT TRADE INFLUENCES GREAT BRITAIN TO MAKE IMPORT CONCESSIONS

Special Correspondence

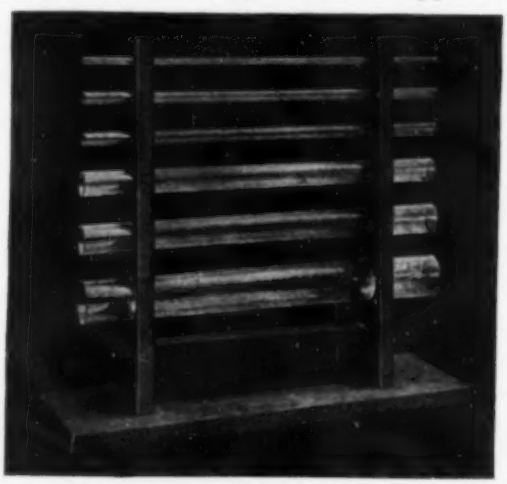
TOKEN imports into the United Kingdom of paints and varnishes, toilet preparations and cosmetics, carbon electrodes and other manufactures are now permitted from four countries—U.S.A., Canada, Belgium and Switzerland—and similar arrangements are likely to be made with other countries. The quantities involved—one-fifth in value of corresponding pre-war imports—are small, so small indeed that British manufacturers do not expect to be in any way inconvenienced by this foreign competition, but the re-admission of foreign products free of license, even though only on a very small scale, is significant because it seems to indicate a change of heart on the part of the Treasury.

A wider change seems to be pending. Although the British delegations in trade discussions with Argentina, France and the Soviet-Union now proceeding are found unwilling to accede to far-reaching demands from the other side, the stumbling block in these and other inter-governmental negotiations is financial, not commercial. If war debts, sterling balances, shipping difficulties and other extraneous complications could be overcome more easily, Britain's imports would probably have already risen more; for the unexpectedly favorable course of exports has enabled the authorities to give more practical support to importers. Recent trade statistics, however, do not yet show any change.

In July exports of chemical manufactures, including drugs, dyes and colors, rose further to £6,471,353, or a new all-time high, while imports at £1,353,191 were less than before the war in value and volume. The picture is different for chemical raw materials where import statistics reflect recent big price advances. The government's system of bulk purchasing of such commodities as vegetable oils and non-ferrous metals has come in for a great deal of criticism, not so much because higher prices had to be paid of late as because of the authorities' shock tactics in announcing price changes. The price of linseed oil for British consumers, for instance, was advanced by over 100 percent without any previous warning to the trade, with the result that paint prices had to be raised by up to 40 percent without notice.

The price of aluminum, reduced in two stages from £100 to £67, was increased to £72.15 to cover the increase resulting from the higher exchange rate for Canadian dollars. These and other price advances are fully justified in the light of changes in the world market, but big advances without prior notification of a pending

TRANSPARENT VITREOSIL (Vitreous Silica)
TUBING AND ROD
Invaluable for Exacting Technical Applications



Highly Transparent to Ultra-Violet Radiation, Chemically and Catalytically Inert. Useful up to 1000°C and under Extreme Thermal Shock, Unusually Resistant Electrically. Homogeneous and Constant in Properties

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Turbo-Topics

The Turbo-Mixer Corporation unit of the Process Equipment Division of General American Transportation Corporation solves the more difficult problems of mixing liquids with liquids, solids and/or gases, by means of a careful diagnosis of each case, interpreted by experienced chemical engineers. The soundness of approaching mixer design from the chemical-engineering viewpoint has been amply demonstrated by the achievements of Turbo-Mixers in the process industries. Our daily experience in solving the mixing problems of many unrelated industries enables us to apply knowledge gained in one industry to another.

This chemical engineering approach can be of great help to you in:

1. Recommending the correct laboratory and pilot plant installation for determination of usable data.
2. Outlining operating technique in pilot plant operation.
3. Analysis and extrapolation of data in design of plant scale equipment.
4. Design of commercial equipment directly from plant data.
5. Conversion of equipment from batch to continuous processes.

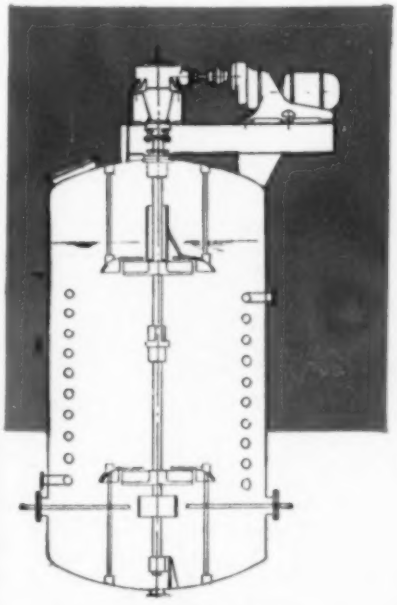
It results in:

1. Elimination of costly trial and error experimental adjustment of full scale equipment.
2. Elimination of duplication of experimental investigations. Experience background covering all process industries enables Turbo engineers to adapt ideas from totally unrelated industries.
3. Installation of trouble-free Turbo-Mixers provides the following specific advantages:

Better Mixing	More Complete Dispersion
More Uniform Product	Increased Plant Capacity
Reduced Power Consumption	Process Simplification
Reduced Mixing Cycle	Uninterrupted Production

It is our practice to specify the mixing equipment necessary to produce a desired result in the most economical and satisfactory manner. Hence, the circulation may be violent or gentle as required, giving you the benefit of CONTROLLED AGITATION, whether the operation is batch or continuous.

Bulletin No. 11 gives further details. Write for a copy.



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Gas Absorber Turbo-Hydrogenator

Other General American Equipment

Dewaterers	*Calciners*
Dryers	*Kilns*
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Evaporators	*Bins*
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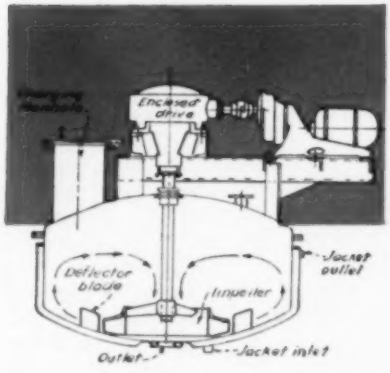
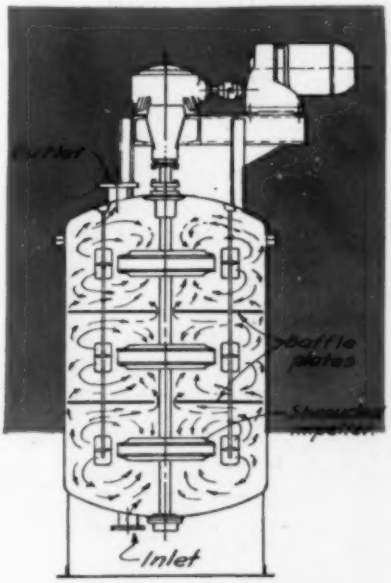


Turbo-Dissolver Used in
Lacquer Industry



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GAT X GENERAL AMERICAN

LUBRIPLATE maintains a durable, load carrying film at the "Friction Point," which reduces friction, retards progressive wear and prevents rust and corrosion. That is why gears lubricated with LUBRIPLATE last longer and run better. Don't take our word for it. Prove it to yourself. Thousands have in every industry.

LUBRIPLATE

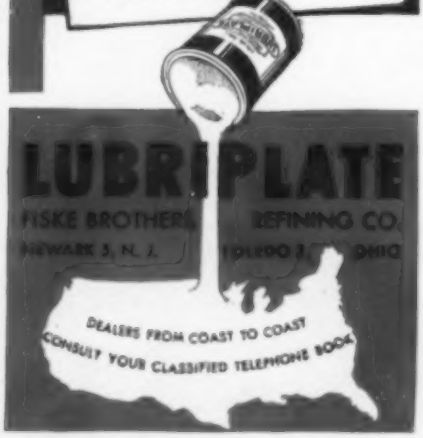
Lubricants definitely reduce friction and wear to a minimum. They lower power costs and prolong the life of equipment to an infinitely greater degree. LUBRIPLATE arrests progressive wear.

LUBRIPLATE

Lubricants protect machine parts against the destructive action of rust and corrosion. This feature alone puts LUBRIPLATE far out in front of conventional lubricants.

LUBRIPLATE

Lubricants are extremely economical for reason that they possess very long life and "stay-put" properties. A little LUBRIPLATE goes a long way.



REDUCING SPEEDS ECONOMICALLY

While gear types may vary to meet different conditions, there are constants that apply to all speed changes. The amount of power consumed and the wear on gears is directly dependent upon the relative smoothness of the operation of the gears. Pitted, scored, galled, rusted, corroded, or extremely worn gear teeth will naturally set up an excessive power drag and consequently effect a substantial increase in power costs. Gear failures necessitate the shutting down of machinery, with time loss during stoppages, and expensive gear replacements. Many gear failures can be attributed to misjudgement in selecting the proper type lubricant, or the inability of the lubricant selected to successfully cope with the requirements of the particular gears and the operating conditions involved.

A durable, load carrying, water and acid-resistant lubricating film must be maintained on gear teeth at all times to assure smooth and continuous operation with a minimum of power consumption. That lubricating film must stand the test continuously at the Friction Point —where the gear set meshes—the point that meets the full force of loads carried—the point where the shocks and thrusts of speed changes are squarely centered. LUBRIPLATE Lubricants have provided the solution to hundreds of both exposed and enclosed gear troubles. LUBRIPLATE has not only kept new gears looking new after thousands of hours of continuous operation but has permitted the re-use of old and worn gears that were about to be replaced.

LUBRIPLATE Lubricants possess that comparatively light body with exceptionally high film strength. LUBRIPLATE has special stay-put properties, protects against rust and corrosion and will not break its film when subjected to excessively heavy loads. Plant managers have not only been able to prolong the life of their gears many times over, but also have been able to realize substantial savings in power transmission costs with the continued use of LUBRIPLATE.

The "LUBRIPLATE SERVICE HANDBOOK" containing valuable information on the subject of lubrication will be furnished without charge by writing Fiske Brothers Refining Company, Newark 5, New Jersey. Adv.

change naturally cause great inconvenience to manufacturers. It would seem that the control authorities are not entirely unmoved by the protests of traders and manufacturers and would not be unwilling to transfer part of the responsibility to private shoulders. The admission of token imports, a freer flow of import licenses in general, and the resumption of free dealings in commodities unaffected by shortages are all due to the Government's desire to give to private dealers more elbow room. Many raw materials for the pharmaceutical industry are soon to be freed of control, though imports presumably will remain subject to license.

Meanwhile the tone of the chemical markets remains unchanged and predominantly firm, though doubts have arisen in one or two directions—e.g., for quicksilver compounds—whether the present elevated prices can be long maintained. It is hoped that more chemical materials will be obtained from continental Europe shortly. The expectation that potash and barytes, among other chemicals, would be shipped to England from the British zone of Germany has not been fulfilled yet, but German barytes may reach the British Isles at the end of this year. In the trade negotiations with France potassic and phosphatic fertilizers are among the commodities which are to be made available in larger quantities during 1946-47. Informal discussions with countries in southern and southeastern Europe have revealed their desire to resume large-scale dealings with England, but production and transport difficulties are likely to keep this trade for the time being within narrow limits.

COAL SHORTAGE

The main obstacle to an expansion of outputs in British chemical factories at home is the shortage of coal. Many firms are now using oil fuel to the maximum extent possible, and alternative coal and oil burning installations are provided in many important extension schemes. Even so the quantitative and qualitative inadequacy of coal supplies, likely to grow more acute this winter, is a source of constant anxiety, and the sharp rise in the prices of industrial fuel tends to offset the gain accruing to manufacturers in the British Isles from other cost advantages over foreign competitors.

Shortages of coal and uncertainties created by the impending national station of the colliery industry are also responsible for the fact that while every month brings reports about new ventures in the inorganic field of chemistry, private enterprise shows little interest in chemical trades connected with the processing of coal and coal derivatives. Yet there are probably greater potential opportunities in this than in any other branch of British chemical industry. The present situation is well illustrated by the report of Low Temperature Carbonisation Ltd., a pioneer in its field, which owing to shortage of coal has been working at half capacity since 1940. The company has ordered additional plant worth over £200,000, but there is little hope of obtaining it for at least eighteen months.

Other coal processing industries are faced with similar difficulties. In the long run,

If you need

ACCURACY OF DIMENSIONS

SUPER REFRACTORY VALUES

HIGH DIELECTRIC STRENGTH

ABILITY TO WITHSTAND THERMAL AND MECHANICAL SHOCK

-make it of Alorco Aluminas

You can count on ceramic products to be "of a size" when their base is an Alorco Alumina. Add to this property their high insulating value and ability to withstand thermal and mechanical shocks, and you understand their popularity with so many manufacturers.

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The spark plugs in your new automobile are being made to the high standards established for aircraft spark plugs—"100% Alorco Alumina", they're specifying. Exhaustive tests and service have proved that these aluminas give superior products.

You may have samples of Alorco Aluminas for use in development work on your own products. List your requirements and call the nearby Alcoa office. Or write ALUMINUM ORE COMPANY, 1910 Gulf Bldg., Pittsburgh 19, Penna.

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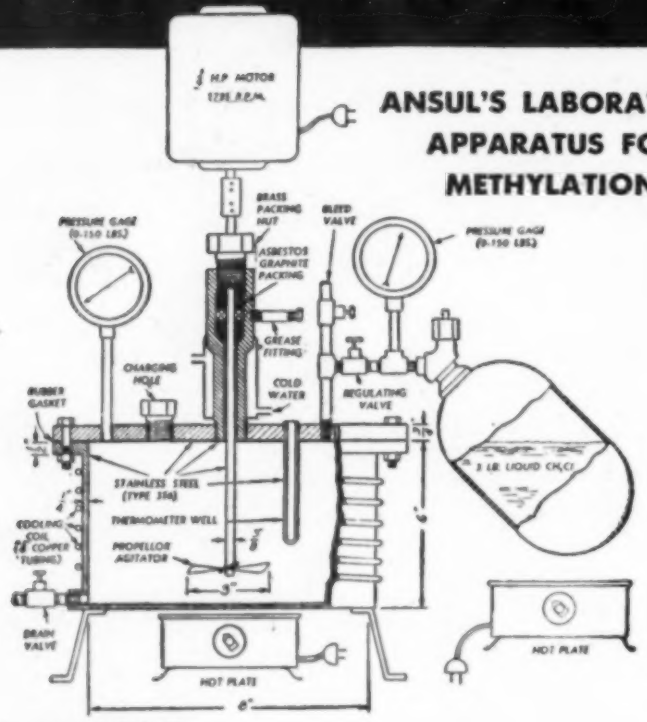
IT'S
Easy to Methylate
with ANSUL
METHYL CHLORIDE



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1—The rate of methylation is high at moderate (30-60 lb. per sq. in. gage) pressure and temperature. (50-100° C.)
2—More stable than other common methylating agents.
3—Can be conveniently weighed, metered, etc.
4—A low-priced chemical available in cylinders and tank cars.

Recommended for methylation of amines, phenols, alcohols, hydrocarbons and others.

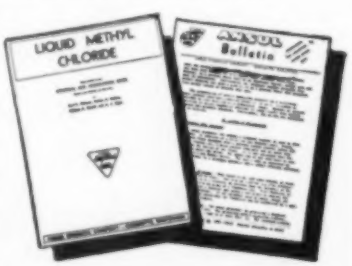
LIQUID Methyl Chloride by ANSUL*

Consult Ansul's research and technical departments on your methylation processes for data of direct benefit to you.

PHYSICAL PROPERTIES

Chemical formula	CH_3Cl
Molecular weight	50.491
Color (gas or liquid)	Colorless
Odor	Ethereal, non-irritating
Melting point	−144° F. (−97.6° C.)
Boiling point	−10.65° F. (−23.7° C.)
Critical Temperature	289.6° F. (143.1° C.)
Critical pressure	969.2 lbs. per sq. in. abs.
Solubility	Methyl chloride in water—3 to 4 volumes methyl chloride vapor in 1 volume of water at ordinary temperatures and atmospheric pressure—methyl chloride in alcohol—readily soluble.
Specific gravity of liquid	.909

*REG. U. S. PAT. OFF.



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ANSUL CHEMICAL COMPANY
INDUSTRIAL CHEMICALS DIVISION, MARINETTE, WIS.
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however, it may be hoped that the coal supply to these plants will improve as coal outputs increase and alternative fuels are used where substitution is possible. If and when this happens, the former British export trade in coal will be replaced by exports of surplus byproducts by coal processors, a development which can even now be watched in its beginnings and is of particular interest to U. S. consumers of coal-tar products, because the United States is the leading British export market for these manufacturers. The mentioned company alone has exported about $1,600,000 of tar acids to the United States since 1939, and liquid products have been placed successfully in many countries of all continents.

PLASTICS EXPANSION

At home great hopes are placed on the plastics industry as an expanding market for organic chemicals, but recent progress reports by leading firms of plastics of producers suggest that the expansion of capacity envisaged under recent extension schemes will not become effective for the next two or three years. The big I.C.I. heavy organic chemicals plant plans for which were announced some months ago after two years of preparatory work will take five years to build if construction schedules are kept; at present the site is being prepared for building operations. It thus appears that expansion and progress in this field, though of great importance in the long run, will not gain momentum before several more years have elapsed.

Another field in which production is hampered by limitation of plant capacity is the fertilizer industry. The sulphuric acid plants are being worked at higher rates than customary; in April-June the contact plants at 90 percent of capacity, leaving little scope for further expansion until more plant is completed. As about half the British sulphuric acid production in non-government factories goes into superphosphates and ammonium sulphate and the industrial users accounting for the remainder cannot cut their takings, the lack of reserve plant for sulphuric acid manufacture is a serious obstacle to further expansion, but the fertilizer factories also lack reserve capacities to bring into production.

Characteristically, supplies of phosphatic and potassic fertilizers from abroad are now up to the target figures, whereas those of home-produced nitrogenous manures fall short of anticipated demand by as much as 15 percent. Maximum production is expected to continue for several years, and the long-term outlook is considered sufficiently promising by the leading producer of phosphatic and compound fertilizers to launch a three-year expansion program involving a capital expenditure of £3,000,000. Part of this sum is to be spent on a 100,000 ton triple superphosphate plant. This product is not at present produced in Britain, but experience with U. S. lend-lease material has created a commercial market for it in the British Isles.

Chemical plant makers are displaying great initiative in an effort to regain and extend old markets and enter new ones. A special mission, the first purely technical mission to leave the country, has

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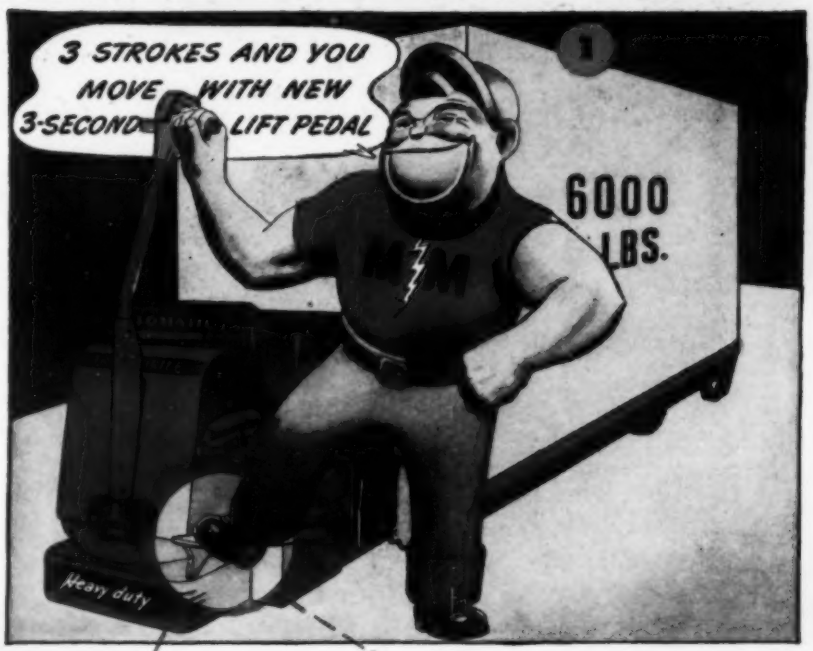

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been sent to the Caribbean oilfields to study on the spot during a three months' tour the specific requirements of the petroleum companies working in these fields, and official quarters both in London and in Trinidad are giving the enterprise their full support.

A $2,500,000 contract for the extension of the Pretoria coke-oven plant of the South African Iron and Steel Corp. has been placed with a British firm. Another firm of chemical plant manufacturers is engaged on orders for complete sugar cane factories for India and Jamaica, sugar cane mills for Brazil and Peru, and important machinery for sugar factories, condensing and centrifugal pumping plant, and power station equipment. It has been the general experience in dealings with foreign firms wishing to place orders for chemical plant that only engineering firms specializing in certain fields of chemical plant, capable of drawing on latest designs and possessing practical experience in operating such plant have any hope of securing large orders for complete installations.

The publication of reports on German plant by the Intelligence Objectives Sub-Committies which have been carefully studied by interested parties in Britain has drawn attention to the advantages to be gained from a free exchange of information between plant designers, and means are sought by which such exchange can be secured without detriment to private interests involved.

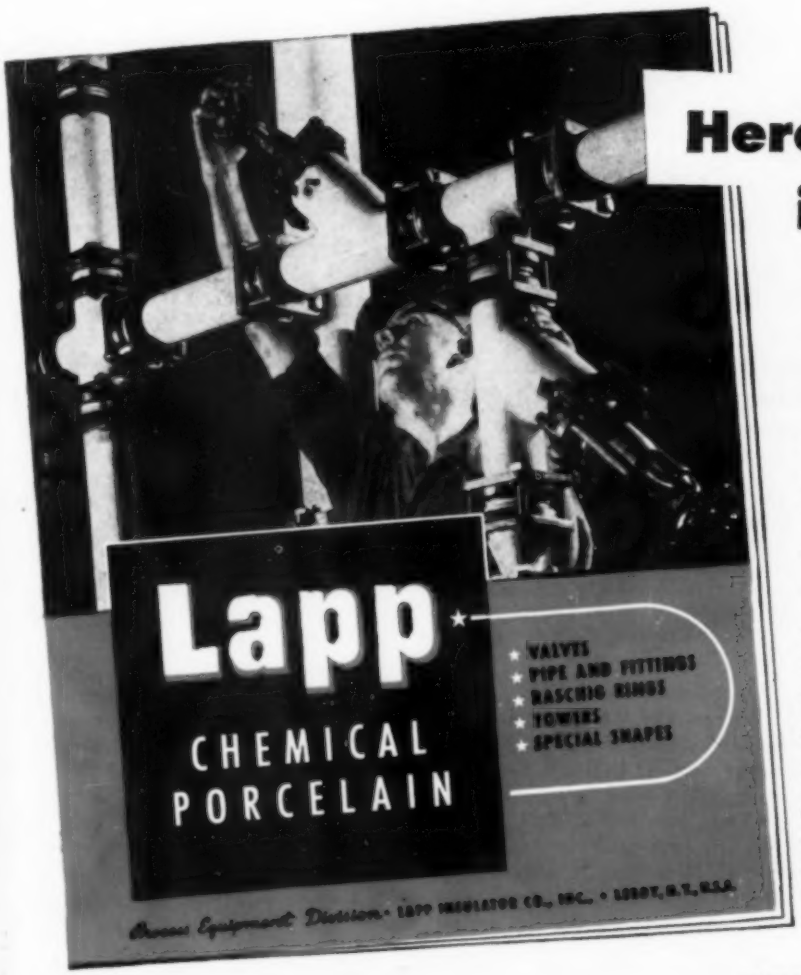
COMMITTEE HEADS NAMED FOR CANADIAN CHEMISTS

At a recent meeting of the board of directors of the Chemical Institute of Canada, Dr. L. Lortie, chairman of the board, announced that the various committees of the Institute for the coming year would be headed as follows: external affairs, Dr. C. A. H. Wright, who is president of the Institute; finance, Dr. E. Lusby; scientific affairs, Dr. R. V. V. Nicholls; membership, J. Charles Honey; professional affairs, Dr. R. P. Graham; and general publicity and national meetings, Dr. J. A. McCoubrey.

NORSK HYDRO IN LARGE EXPANSION PROGRAM

Large postwar demand for nitrogenous fertilizers and the removal of Germany and Japan as immediate competitors have influenced the directors of Norsk Hydro, one of the largest electrochemical concerns in Norway, to schedule an expansion program which will cost 45,000,000 Kr. and will increase the company's production of nitrogen by 20,000 tons a year. Incidentally, there is a contest raging regarding the ownership of shares in the company. Before the war, French interests had a majority interest but in 1941 when Norway was occupied by the Germans, the French Vichy Government transferred a number of French-owned shares to Germany. After the war these shares were taken over by the Directorate for Enemy Property. The French courts have declared the stock transfer illegal and diplomatic agencies in France and Norway are concerned with the settlement of the controversy over ownership.

GOT A PROBLEM IN PROCESSING OR HANDLING CORROSIVE CHEMICALS?



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THIRTY COUNTRIES REPRESENTED AT INTERNATIONAL TECHNICAL CONGRESS HELD LAST MONTH IN PARIS

Special Correspondence

TWELVE hundred of the world's leading engineers, drawn from all trades and from thirty countries (including the U. S.), met last month in an International Technical Congress in Paris. They exchanged information in a dozen languages, visited industrial plants, and listened to speeches —in French and English—on the present and future tasks of engineering on this globe.

Chief result of the Congress occurred on the sidelines—the unanimous decision by the chief delegates from all countries to set up an interim organization with the view that this will grow into a World Engineering Federation. The proposed federation would mobilize the engineering knowledge of the world to aid the various United Nations' bodies in such tasks as reconstruction, economic advancement, and the spread of engineering knowledge and cooperation. This idea grows out of meetings which first began to be held in London as early as 1944, among engineers of various nations who were assembled there by the war.

The new interim organization, to be known as the "World Engineering Conference," is to be composed of representatives from engineering societies of all nations. It will be directed by an executive board representing twelve countries. Three places on this board have been left vacant to allow inclusion of countries, such as the USSR, which were not represented at last month's Congress.

The new Conference's members, and its secretariat, will sound out national engineering associations on the sort of permanent World Engineering Federation which they desire. The Conference will try to work out a plan which will tread on nobody's toes. Then other Congresses will be summoned with the object of eventually inaugurating the World Engineering Federation.

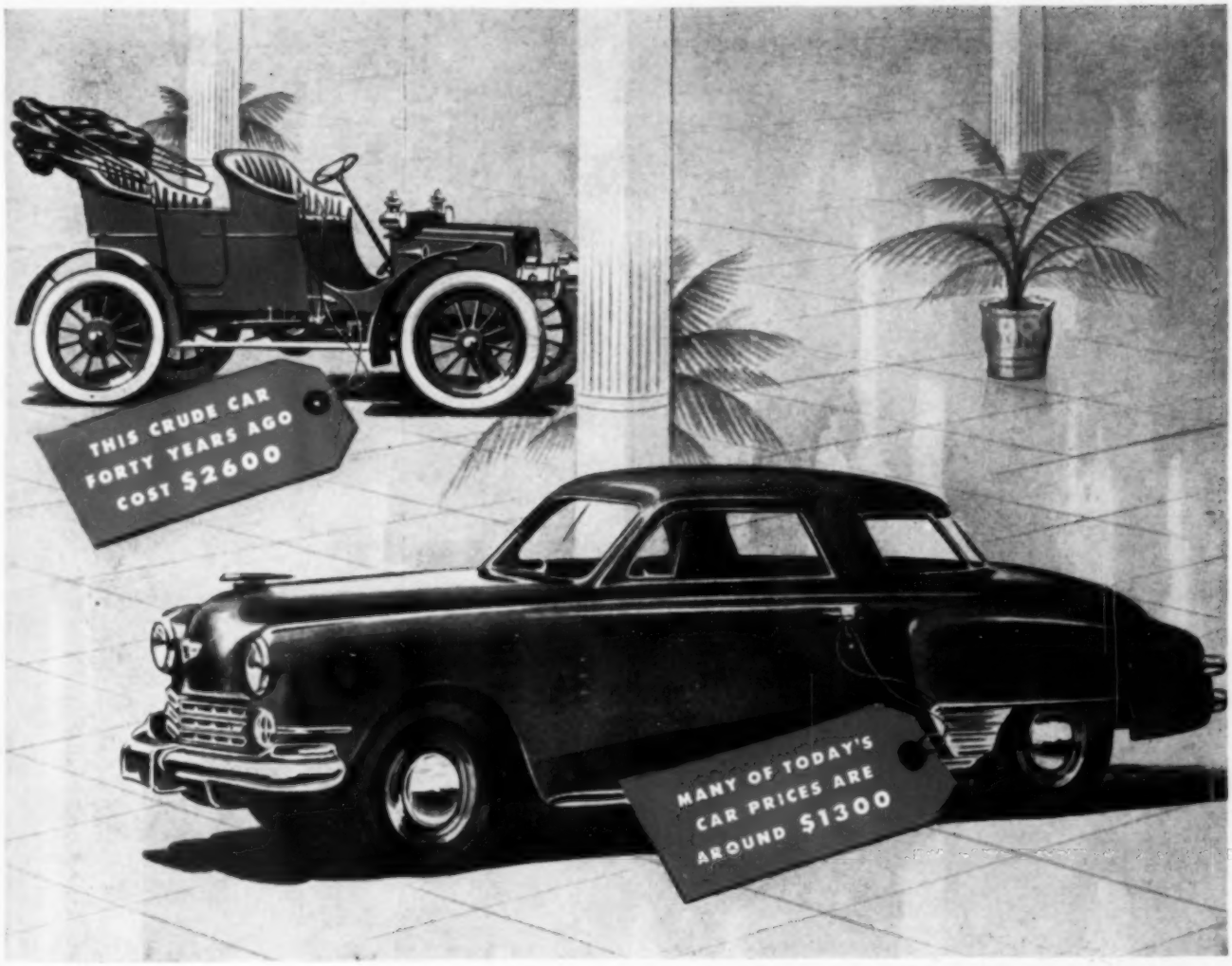
Meanwhile, the interim conference will be available to respond to calls for help from UNESCO or similar organizations. President of the new Conference, as of the Congress, is Mr. Antoine, inspector general of Electricite de France. America's temporary representative on the executive board is Fenton B. Turck, member of the Joint Committee on International Relations of the Engineers Joint Council of the U. S. Other countries represented on the Board are Great Britain, Poland, Switzerland, Czechoslovakia, China, India, and Egypt.

The Congress itself plowed through summary discussions of 130 reports in its five days, and ended by approving a spate of resolutions. It considered, under four headings:

The engineering problems provoked by the tremendous reconstruction needed in today's world, and the problems of industrializing backward areas. These sessions provided a bird's eye view of many of the national plans now getting under way in devastated countries, as these plans seem to the engineers charged with their fulfillment. The reports all looked to a dogged rebuilding of economies wrecked by war, in some cases twice wrecked in one lifetime.

Peacetime use of atomic energy, featuring an eagerly awaited paper by Harry A. Winne, vice president of General Electric

American delegation with French engineers meet to discuss the International Technical Congress and the World Engineering Conference. Left to right, front row—Morris Cooke, consulting engineer; Col. A. Antoine, president of the International Technical Congress; Col. C. E. Davies, secretary of the American Society of Mechanical Engineers; M. Chalon, president of the Societe des Ingenieurs Civils de France; Fenton Turk, president of Turk Hill (Consulting Engineers) Co. Back row, left to right—E. R. Purves, director of public and professional relations, The American Institute of Architects; M. Mennier, organizing secretary for the World Engineering Conference; George Gilles, president of the Federation of French Engineering Associations and Societies; W. J. Gargest, McGraw-Hill Publishing Co. Ltd., London



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Many other examples of how work pays could be cited. Only through increased production . . . not slow-downs or idleness . . . can real income-increases be attained. Distortions of that truth may persist, but the fact remains. And the public must be reminded, repeatedly, that only through increased production can the masses benefit by technological advances of recent years in industry.

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Co. and member of the Lilienthal Committee, was presented by his colleague Dr. Everett S. Lee.

The present engineering status of all the world's industries, a section which produced many economic as well as technical summaries of different industries' positions in various countries.

A section on engineers and technicians in the world today provided varied reminiscences; descriptions of where engineering education stands not only in advanced countries but in colonial or non-industrialized lands; proposals for educational reform; and above all a unanimous call for engineers to work together internationally for peace and reconstruction, hearkening to their duty as citizens and their human responsibilities.

The Congress' resolutions also emphasized this last point—the social responsibility of engineers to work for human progress in their own fields, and to organize nationally and internationally in grouped associations for diffusion of their knowledge.

Specifically, the Congress recommended that the United Nations organize an engineering staff in its secretariat, call upon engineers for help in reconstruction, and form sister organizations to the Food and Agriculture Organization in the fields of housing and city-planning, and the scientific organization of labor. The Congress also called for creation of one or more international engineering schools, the first to be set up in Europe.

Among the manifold reports presented to the Congress, two by Americans provoked most interest. A whole morning was devoted to Mr. Winne's paper on peacetime use of atomic energy. Mr. Winne, who has recently taken over general supervision of the Hanford atomic plant, revealed that the Hanford pile so far produces energy at too low a temperature to be used commercially. Warning against over-optimism, Mr. Winne foresaw atomic energy's chief peacetime use as a source of power for ships, and of electricity for areas far from coal or water power. It will prove especially valuable for large submarines he predicted. Its use in locomotives, autos, manned planes, or homes, seems far-fetched or impossible, because of the heavy lead guard needed around the radioactive radiations. Another tremendous peacetime field will be development of radioactive isotopes, which should lead to great progress in medicine, chemistry, and metallurgy. At present, the report continued, economic factors are extremely uncertain.

FRENCH ALKALI INDUSTRY

Special Correspondence

FRENCH production of alkalis, including soda ash, caustic soda, bicarbonate, and soda crystals, is confined to four important firms: M. M. Solvay et Cie which operates three plants in the eastern part of the country and one plant in the south; Manufacture des Glaces et Produits Chimiques de St Gobain, Chauny et Cirey, operating one plant in eastern France; Marcheville et Daquin Cie with one plant in the east; and Societe d'Etudes et Produits Chimiques with a plant in the southwest. Some of these plants suffered considerable damage due to bombing and also

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- Non-resonant, energy absorbing.
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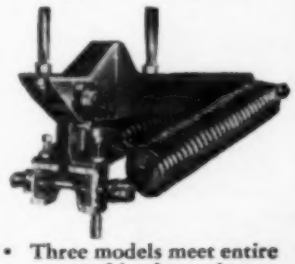

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from the removal of equipment to Germany.

At present production is getting back to the prewar level with caustic soda output in July running around 10,000 tons as compared with 9,900 tons in June and 9,500 tons for the comparable month in 1938. Soda ash output in July was 41,700 tons against 40,250 tons in the preceding month and 40,000 tons as a prewar normal.

So far as raw materials are concerned, sodium chloride and lime are readily available as they are found in the vicinity of the plants. The problem of coal is more serious not because of insufficient supplies but because the coal is of low grade containing about 15 percent of foreign material. Shipping likewise is complicated by the shortage of railroad cars, trucks, and boats. The most important part of the river fleet had been taken by the Germans during the war.

A shortage of packaging materials also offers a problem as there is a lack of jute bags and of metal for making drums. Hence deliveries are handicapped in two ways and plans for increasing outputs are affected by the poor condition of equipment which has had no replacements in the war years. Labor also is short supply, both technical and ordinary workers, and this further restricts expansion of production.

Attempts to modernize plants is retarded by lack of funds and especially by the lack of credits in outside countries from which new equipment might be obtained. Because of the financial situation, the government is reserving a part of current production for export trade which action is favorable for building up outside credits but is holding back developments in domestic lines. However, the government favors the export business in order to be able to pay for large purchases abroad. Furthermore, other countries which are producers of alkalis are not able to satisfy export requirements and this gives France an opportunity to better its position in export markets.

TUNG OIL SHIPMENTS FROM CHINA WILL BE LIGHT

Writing from Shanghai, a representative of *McGraw-Hill World News* says that for many months, tung oil shipments from China will be very light. At present there are only 14,000 tons available and the new crop will not begin coming in until December. Even the stocks of 14,000 tons is not a true picture because 2,000 tons are earmarked for Russia as part payment for military supplies furnished during the war. At least an equal amount will be consumed domestically and transportation difficulties probably will take another cut by making it impossible to get supplies to a shipping port.

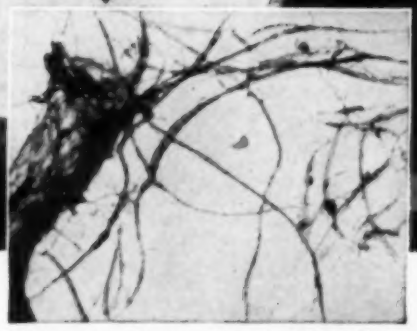
The new crop will be about 50 percent of the prewar normal of 100,000 tons. The decline is due to cutting of many trees for firewood and a cessation of replanting during the war when there was little market for the oil. Thus stands are greatly reduced and replacement growths are wholly lacking. It will be at least three years before production can reach prewar levels.

What production there is in Szechuan, Hunan, and Hupeh may take a long time getting to market. Most shipping facili-

HOW CALCO USES THE RCA ELECTRON MICROSCOPE TO IMPROVE PRODUCT QUALITY

Pictures courtesy of "Textile World"

RCA Type EMC electron microscope used by Calco to speed textile and pigment research.



Disintegrated Cotton Fiber X20,000—Calco uses such micrographs to study fibers and thus determine proper dyeing technique.

Vat Green Dyestuff X20,000—Crystal size and shape are important properties in determining suitable dyeing applications.

The Calco Chemical Division, of the American Cyanamid Company, uses the RCA desk-type electron microscope in developing new and improved dyes, pigments, and textile finishes. This remarkable instrument has proved invaluable in this company's research on the size and structure of particles, surfaces, and fibers.

Magnifications of 500 or 5000 times are obtained with useful photographic enlargement up to 100,000 diameters. Calco reports:

"The electron microscope is particularly well suited to the study of pigments and insoluble dyes. For maximum hiding power, tinting strength, and coloring value, the primary particle size of pigments must be well below the dimensions that can be clearly resolved by visual light.

"The electron microscope, utilizing electrons instead of light waves, has a resolving power many times that of the ordinary light microscope, and shows with great clarity the outlines of individual particles. It reveals not only the shape and surface smoothness but frequently the structure of secondary aggregates.

"The studies which have been possible with the electron microscope have contributed materially to the development of pigments with improved properties and performance."

In an impressive number and variety of industries and institutions, the RCA electron microscope is uncovering new knowledge, speeding research, and improving product quality and performance.

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Our electron-microscope engineers will gladly help you appraise the possibilities of the desk-type or the even more versatile "universal" type RCA electron microscope in connection with your work. Write Dept. 23-J, Electron Microscope Section, RCA, Camden, New Jersey.

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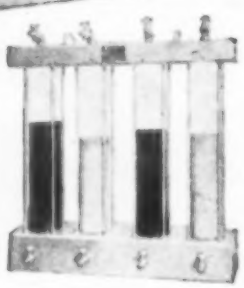

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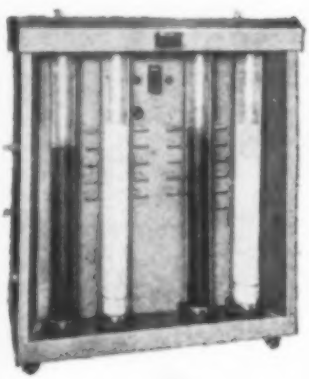

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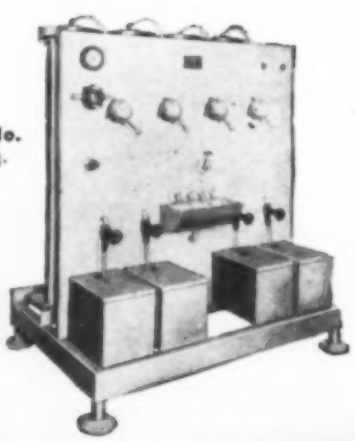

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Employing two cation resin beds and two anion resin beds they deliver water of more than twice the purity of two-bed models. These four-bed models also "stay on the line" longer between regenerations — usually nearly three times as long as two-bed units. This represents not only savings in material, but much less work for the operator.

There are thirteen standard models in the complete line in capacities of from 3 to 1000 gallons per hour. Whatever your need for de-ionized water remember you get greater purity, lower cost, and operating advantages no other equipment can offer with a Barnstead "Double-Action" unit.

Cat. No. FM-0. *A compact bench model for Laboratories and small industrial needs. Brings the advantages of higher purity and greater economy to the small and moderate user of de-ionized water. Capacity from 3 to 12 gallons per hour.*

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Cat. No. FM-3. *Ruggedly built unit for industrial use, this is the finest de-mineralizing equipment available. Incorporates many Barnstead improvements in design. Capacity from 20 to 1000 gallons per hour.*

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ties are commandeered by the National Armies for transporting troops and supplies, so little commerce is possible between Shanghai and inland Yangtze points. Since V-J day shipments of oil from China have amounted to 9,917 tons. About one-half of this went to England and 40 percent to the United States. The largest exporter is China Vegetable Oil Corp. which handles about 90 percent of shipments.

Under recent exchange revision it still is possible for exporters to get under United States ceilings but the price is expected to go up soon. Up to about the middle of August the domestic price per long ton was the equivalent of $625 per long ton but on August 17 this was marked up to the equivalent of $688. Actually tung oil is a cheap commodity in present day China. In the old days one picul (133 lb.) was worth four piculs of rice in exchange. At present one picul of wood oil will get about one picul of rice.

With regard to exportable surplus for the next year, it is difficult to make a reliable estimate. Much depends on whether or not North China which was the largest prewar domestic consumer, comes back into the market. Home consumption formerly ran about 30,000 tons a year and if this business returns, the export volume probably will amount to less than 30,000 tons.

RUSSIA RESTORES PLANTS DAMAGED IN WAR

Producing again is the first section of the nitrogen fertilizer plant in Dnieprodzerzhinsk in the Ukraine, the last of the Nazi-wrecked enterprises in the city to launch operations. The second section is scheduled to begin producing by the end of this year.

The work of restoring the Volkhov Aluminum Plant is nearing completion. The Leningrad Aluminum and Magnesium Institute has worked out a new technological progress for the plant. Nepheline instead of bauxites will be used as raw material. The new raw material is a cheap byproduct obtained in the mining of Karelian apatites.

NEW FERTILIZER COMPANY FORMED IN EGYPT

A new company, The Egyptian Chemical Industries, has been founded in Egypt for the production of artificial fertilizers. Its output is planned to amount to from 200 to 300 thousand tons annually, which represents about half of the local requirements of this commodity before the war. Production is expected to commence at the beginning of 1948.

SMALLER LINSEED CROP FORECAST FOR INDIA

The 1945-46 linseed crop for India is estimated at 369,000 tons in the final forecast of the Department of Commercial Intelligence and Statistics, a fall of 6 percent from the 1944-45 crop which totalled 392,000 tons. Acreage under cultivation decreased 3 percent to 3,376,000 acres during the year. Although the crop suffered heavily from a winter drought the remainder is in fairly good condition.

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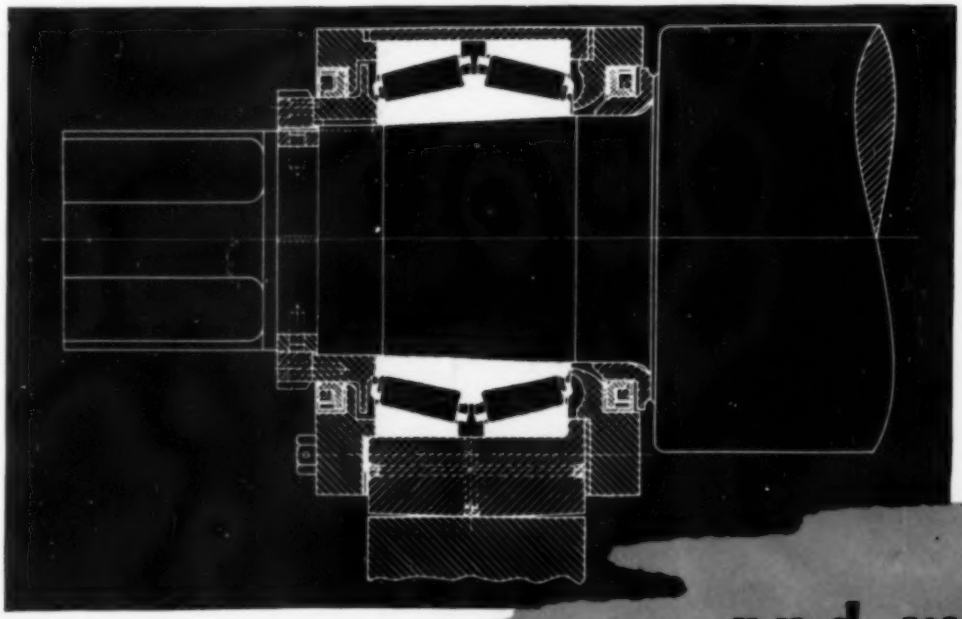

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Report on Underground and Dispersal Plants in Greater Germany—As a result of heavy bombings, a gigantic underground and dispersal program began. It was shown that properly designed and ventilated oil plants could be operated underground with reasonable safety, but the Germans were confident of quick victory and started too late on the program. American observers felt that centralized underground plants connected by pipelines would have been the most effective. The underground and dispersal program, as originally formulated, was expected to supply Germany with 82 percent as much aviation gasoline as had been produced in January 1944, 25 percent as much motor gasoline, half as much lubricating oil of all types, two-thirds as much aviation lubricating oil and 88 percent as much diesel oil. But, despite prodigious efforts, only about a million barrels of straight-run gasoline and diesel oil and a small amount of a blending agent were obtained up to the end of the war. The whole program called for 140 separate plants, costing 1,400,000 RM and would have required 200,000 men's labor for a full year. The scarcity of labor and materials, the loss of construction sites, and the damaged railroads interfered with this plan and in the last few months, it was cut by half. The German oil industry could have been paralyzed by strategic bombing even if the whole program had been completed. This report includes charts showing the utilization of the oil products, the labor needs and labor costs. Maps of the plant locations and diagrams of the plants and apparatus are shown. Photographs of the equipment, some of it underground, are also included. (U. S. Strategic Bombing Survey, PB 23372; Oct. 1945; 196 p.; M. $2; P. $14.)

Some Aspects of the German Leather Industry—This report describes visits to several of the larger German sole and upper leather tanneries in the American, French and British zones. Except where it was in the interests of the national economy, little was done during the war to improve or develop the existing leather processes. The development of leather substitutes, tanning materials, and equipment is described. Information obtained in interview with Dr. Ing. Karl Felzmann of the leather products development division of I. G. Farbenindustrie A. G., Ludwigshafen, is presented under the following headings: Leather finishes of synthetic resin, casein-pigment and nitro cellulose; iron tannage, Ferrigan P.; synthetic tanning materials, Tanigans; aluminum tannage, Blancorol; oil tannage, Immergan, etc. A list is given of available pamphlets, some in English, concerning the properties and methods of use of various tanning and waterproofing agents. Descriptions of factories and processes of the following firms are also included: Joh. Knecht & Sohne, Elmshorn, Holstein; Lederwerke Wiemann A. G., Neumunster, Holstein; Norddeutsche Lederwerke A. G., Neumunster, Holstein; Herman G. Schmid, Neumunster,

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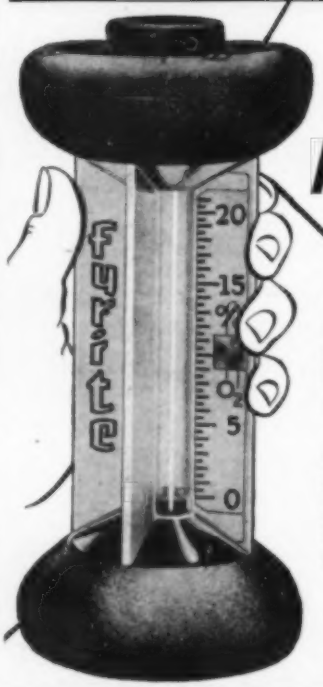

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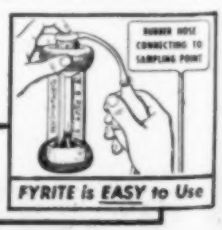

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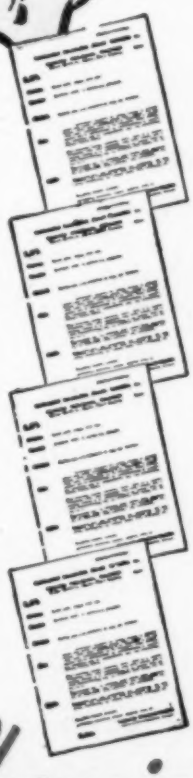

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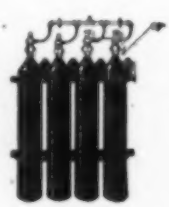

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German Chemical Plant With Particular Reference to Centrifuges—The plants visited and a few of their particulars are: (1) Elmore Metall A. G., located at Schladern on Sieg, where there is manufactured electrolytically deposited copper shells, the works being divided into two sections, one being a tube drawing section, and the other making electrolytically deposited copper cylinders (which may be used in centrifuges). (2) H. Krantz Maschinenfabrik, Aachen, specializing in hydro extractors suitable for laundries and textile works; (3) O. Dorries A. G., formerly Banning and Seybold, Duren, producing "erkensators" a centrifugal machine for the romoval of impurities from paper stock; (4) I. G. Farbenindustrie, Dormagen, using Escher Wyss centrifuges in the cellulose acetate plant; (5) I. G. plant, Elberfeld, using Wyss centrifuges in the hexamethylenetetramine plant; (6) Glanstoff Courtald, between Cologne and Dormagen, in which water was extracted from viscose cakes in the cake washing plant, using (a) multiple hinged candle hydro extractors and (b) converted spinning pots; (7) Matthes and Weber, Duisberg, using Escher Wyss centrifuges in the bicarbonate plants; (8) Westfalia Separator A. G., Oelde, specializing in high speed centrifuges of the Laval type; and (9) Escher Wyss Ravensburg, manufacturing both centrifuges and spray dryers. (F. Broadbent, PB 22184; Feb. 1946; 19 p.; M. 50¢; P. $2.)

German Chemical Plant Manufacture—The engineering works of Werner and Pfleiderer at Stuttgart was visited in order to investigate the developments in mixing and grinding machines for chemical processes during the war. This plant was bombed four times but was yet able to approach a production rate of 75 percent of prewar production. Photographs of single and double bladed and rubber mixers, of a disc shredder for the rayon industry, and of a centrifuge for screening viscose are shown. Very brief descriptions of these machines are given. (J. H. W. Cobbing, PB 25647; n.d.; 11 p.; M. $1; P. $1.)

Silver Solder for High Temperature Service—The development by Junkers of a solder composed of 85 percent silver and 15 percent manganese called "silma" for joining austenitic steels in high temperature applications such as gas turbine blades is described. The material has high strength up to 850 deg. F. and avoids the harmful intercrystalline corrosion of austenitic steels caused by copper and coppe. containing alloys. The investigators state that of all metallurgical developments in connection with German gas turbine activity the silver-manganese solder is likely to have most significance for possible American use; that it was almost the only German metallurgical development not predicated on material shortages of a kind and urgency that do not prevail in the United States. It is the further opinion of the investigators that while American gas turbine blade materials far surpass those used in Germany, this German solder appears to be superior for high temperature use with austenitic steels to any material previously available in the United States and that it should find considerable usefulness not necessarily for fastening turbine blades alone but for general joining of stainless steel in high temperature

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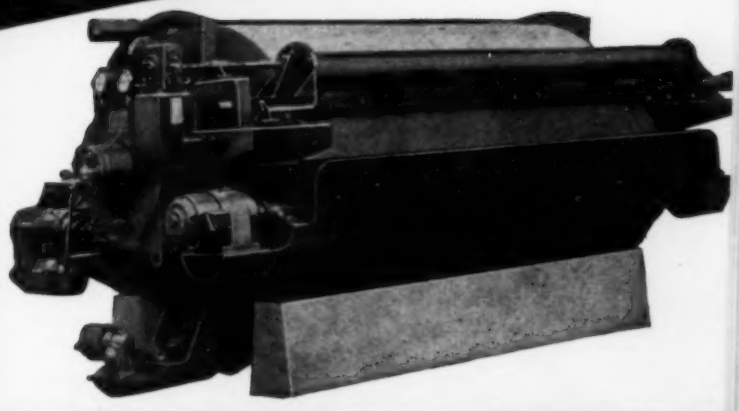
With the Panel Filter, no "precoat" is used, the solids in the pulp forming the cake. The cake forms on the sectionalized filter cloth and is removed by an ingenious floating wire discharger. No wire winding is used on the filter.



OLIVER PRECOAT FILTER

The Precoat Filter, essentially a clarifying unit, operates with a pre-formed filtering medium or "precoat", usually diatomaceous earth. Solids which would plug filter cloths or be difficult to discharge from conventional drum filters form a layer on the surface of the precoat as the drum rotates through the pulp. At the discharge point the film of solids is continuously shaved off by a knife edge geared to travel slowly inward. A fresh surface of filter aid is thus presented at all times for cake formation. The cake, as it comes off, usually has some of the "precoat" mixed with it.

These two Oliver Filters have been developed to handle pulps producing just such filter cakes. The choice depends to a large extent upon density of the pulp and character of the solids. With both, washing of the cake is practicable.

For most operations, the standard Oliver Continuous Vacuum Filter will form and discharge cakes satisfactorily. The Continuous Precoat and Continuous Panel Filters are for products which form cakes with sticky, slimy, "hard to discharge" solids. Both filters are available in a wide range of sizes.

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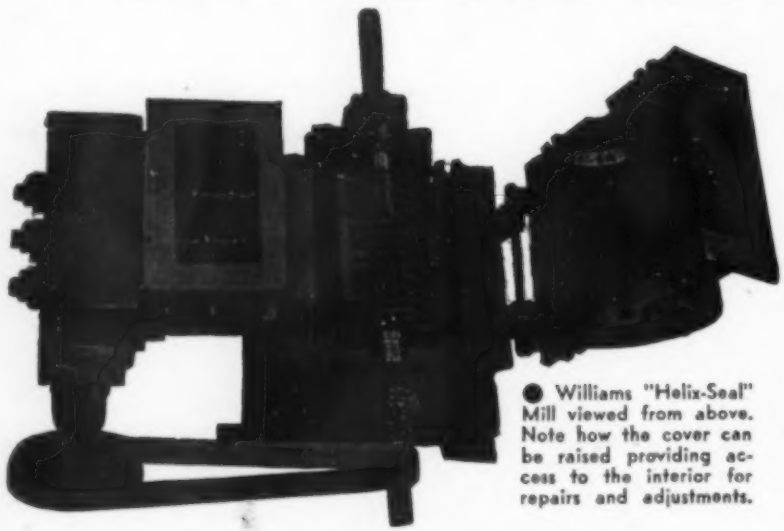

● Williams "Helix-Seal" Mill viewed from above. Note how the cover can be raised providing access to the interior for repairs and adjustments.

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applications such as heat exchangers, exhaust manifolds, gas turbine sheet metal parts, chemical equipment, etc. The following treatment is presented: The properties of the solder, metallurgical reasons for composition manufacture, methods of use and appropriate fluxes. (P. R. Vogt and H. A. Huebotter, PB 23086; Oct. 1945; 7 p.; M. 50¢; P. $1.)

German Dyestuffs and Intermediates; Sodium Hydrosulphite, Sodium Sulphoxylate; Industries—Report describes the production of I. G. Hochst, Frankfurt am Main of the following: pyranil, nitropyrene, amino pyrene, chloranil and Sirius Light Blue. There is a description of the azo-dye plant including vats, presses, ice plant and dryers. Information was also received about the constitution of the metachrome dyes. Report also describes the production at the I. G. Farben plant at Leverkusen of zinc hydrosulphite, sodium hydrosulphite and sulphoxylates (Rongalit). Flowsheets of the zinc hydrosulphite process are attached. (P. C. Holmes, PB 22409; Feb. 1946; 22 p.; M. 50¢; P. $2.)

Synthetic Coatings for Gasoline Tanks—A visit was made to the Schwamler Iron Works at Schwelm which had made many of the large tanks used in German warships and tankers, and also claimed to be one of the larger producers of "jerry" cans, the ingenious closure of which was developed by Herr Grünvogel of this firm. The application of synthetic coatings to the inside of tanks used for gasoline storage was investigated. Details of method are given in this report. For small tanks (up to 250 gal.) baked phenol-formaldehyde resin coatings were used. For larger tanks where baking was impractical or impossible, a plasticized, nitrocellulose, air-dried lacquer was used. This lacquer, however, was modified by the addition of a soluble urea-formaldehyde resin which was cured by the addition of phosphoric acid to affect good adhesion, and to render the film insoluble in gasoline. Tanks coated with this lacquer have been satisfactory in service for a period of at least three years. The composition of the lacquers used was learned from the Wiederhold Lacquer Company at Hilden which supplied them. Information concerning the resins used in the lacquers was obtained at I. G. Farbenindustrie in Hochst. Here, also the method of coating concrete tanks used for the storage of gasoline was obtained from Dr. Dietz who supervised the construction of such tanks in North Africa, western France, and elsewhere. (J. W. Biddle, PB 22812; Aug. 1945; 4 p.; M. 50¢; P. $1.)

Production and Use of Hydrogen Peroxide by the Germans During World War II—This is an address presented by Capt. McKee, USN, before the American Society of Mechanical Engineers, describing the physical properties and uses of hydrogen peroxide. Hydrogen peroxide was also called Ingolin and T-Stoff. The peroxide is very explosive and practically any oxidizable substance can act as a catalyst to cause an explosion. However, it is possible to store it safely in stainless steel, glass, ceramics, polyvinyl chloride and other synthetic plastics. As the temperature rises stabilizers may be added and the peroxide rendered safe. Peroxide has been used by the Germans as a primary and secondary fuel. As a primary fuel the heat of dissociation of H_2O_2 into H_2O and O_2 produces 994 B.t.u. per lb. This is only one tenth that of a pound of oil but it has the further advantage of providing oxygen where needed. As a primary fuel, it powered V1 and V2 rockets. The hydrogen peroxide was mostly used as a secondary fuel because more heat can be obtained from a fuel mixture. The temperature reached is about 2,200 deg. C., which is too high and the Germans add water which brings the temperature down to 550 deg. C. As a secondary fuel, the peroxide was mixed with decalene (suphur-free diesel oil) or methyl

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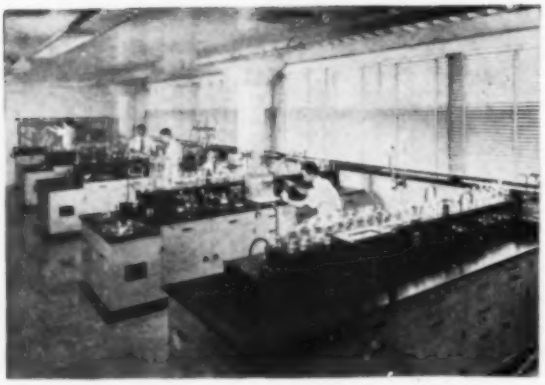

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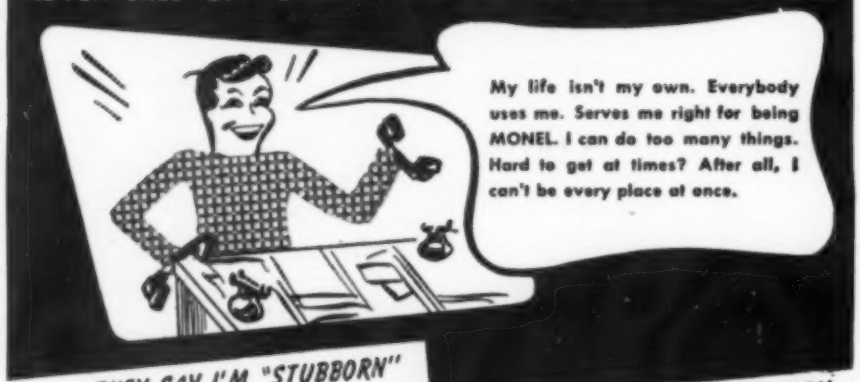
My life isn't my own. Everybody uses me. Serves me right for being MONEL. I can do too many things. Hard to get at times? After all, I can't be every place at once.

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I resist so many things — non-oxidizing acids, alkalies, salts, water, food products, organic substances, high temperatures. Rust? I'm immune to it. Abrasion? I seem to wear forever.

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where product purity, flavor and clarity are essential. But that's because I'm non-contaminating. Actually I'm tough, hard and extremely strong — much more than common brass or bronze.

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"Buffalo" Monel Wire Cloth is woven in a large range of meshes from very fine to coarse, in all standard weaves.

alcohol. A mixture called "Helmann" which combined the fuel and a liquid catalyst was sometimes used. As a secondary fuel, peroxide was used to power torpedoes, submarines and airplanes. (Logan McKee, PB 18798; Mar. 1946; 11 p.; M. 50¢; P. $1.)

The Manufacture of Synthetic Butter—During the war years, a synthetic butter was being manufactured by the Deutsche Fettsaure Werks in Witten (Ruhr), Germany. The output of finished product was 11,000 lb. per day. The process involved the manufacture of straight chain aliphatic acids of C_{11} and C_{12}, and their esterification with glycerine. The resulting ester mixture was refined and purified. It was sold largely to hospitals where it was favored for certain diets, and the remainder was purchased by the German army. The product was competitive with margarine in price and could have been sold with profit at 60 percent of the price of natural butter. (M. E. Spaght, PB 23753; Oct. 1945; 5 p.; M. 50¢; P. $1.)

The Preparation of Tetrahydrofuran Polymers as a Synthetic Lubricant for Metals—The information given was obtained from Dr. Delfts of I. G. Farbenindustrie during an interview at the Leverkusen Plant on May 26, 1945. It has been found that by a complicated procedure, tetrahydrofuran will polymerize, in the presence of a catalyst, to compounds having properties desirable in a lubricant. The nature of the polymeric complex can be changed by the addition of copolymerizing substances such as ethylene oxide and its derivatives. The nature of the polymer ranges from liquid to a relatively tough solid melting at about 60 deg. C. The physical state for a particular use depends upon the catalyst used, the temperature of operation and the molecular ratio of tetrahydrofuran to other copolymerizing components. From a long research it has been shown that the best catalyst is a complex of ferric chloride and thionyl chloride. Special materials of construction are needed because of the corrosive nature of the reaction medium. A simple polymer of tetrahydrofuran has been made which is identical with polybutylene glycol. This glycol and its esters have also been used as lubricants. Compounds have been made for crankcase lubrication of internal combustion engines and for high temperature steam lubrication applications by the co-reaction of tetrahydrofuran with 50 and 25 parts by weight of ethylene oxide respectively. The involved process of manufacture, the limited availability of the necessary raw materials and the cost would preclude any large scale production of these lubricants in competition with refined natural hydrocarbons. No operating or performance data are available for these synthetic oils. The basis for their lubricating value to date is dependent on their physical properties. A synthesis is also described for the production of the tetrahydrofuran monomer from formaldehyde and acetylene by liquid phase condensation. (R. A. Schade, PB 22713; Jun. 1945; 7 p.; M. 50¢; P. $1.)

Report on Visit to I. G. Farbenindustrie Plant at Hoechst/Main—This report contains information obtained on the manufacture of solvents and miscellaneous chemicals at the Hoechst-am-Main plant. Also included in the investigation was the polymerization of vinyl acetate to the various types of Mowilith. The Hoechst plant was the largest manufacturer of solvents and related chemicals in Germany. This plant manufactured vinyl acetate by utilizing a vapor phase catalytic process. The catalyst is active charcoal upon which zinc acetate is deposited to give a zinc content of approximately 15 percent. Glycerine was manufactured by the reduction of hexoses. N-B butyl alcohol was synthesized from acetaldehyde at a maximum capacity of 700 tons per month, or approximately one-quarter of the German production of n-butanol. Crotonaldehyde was pro-

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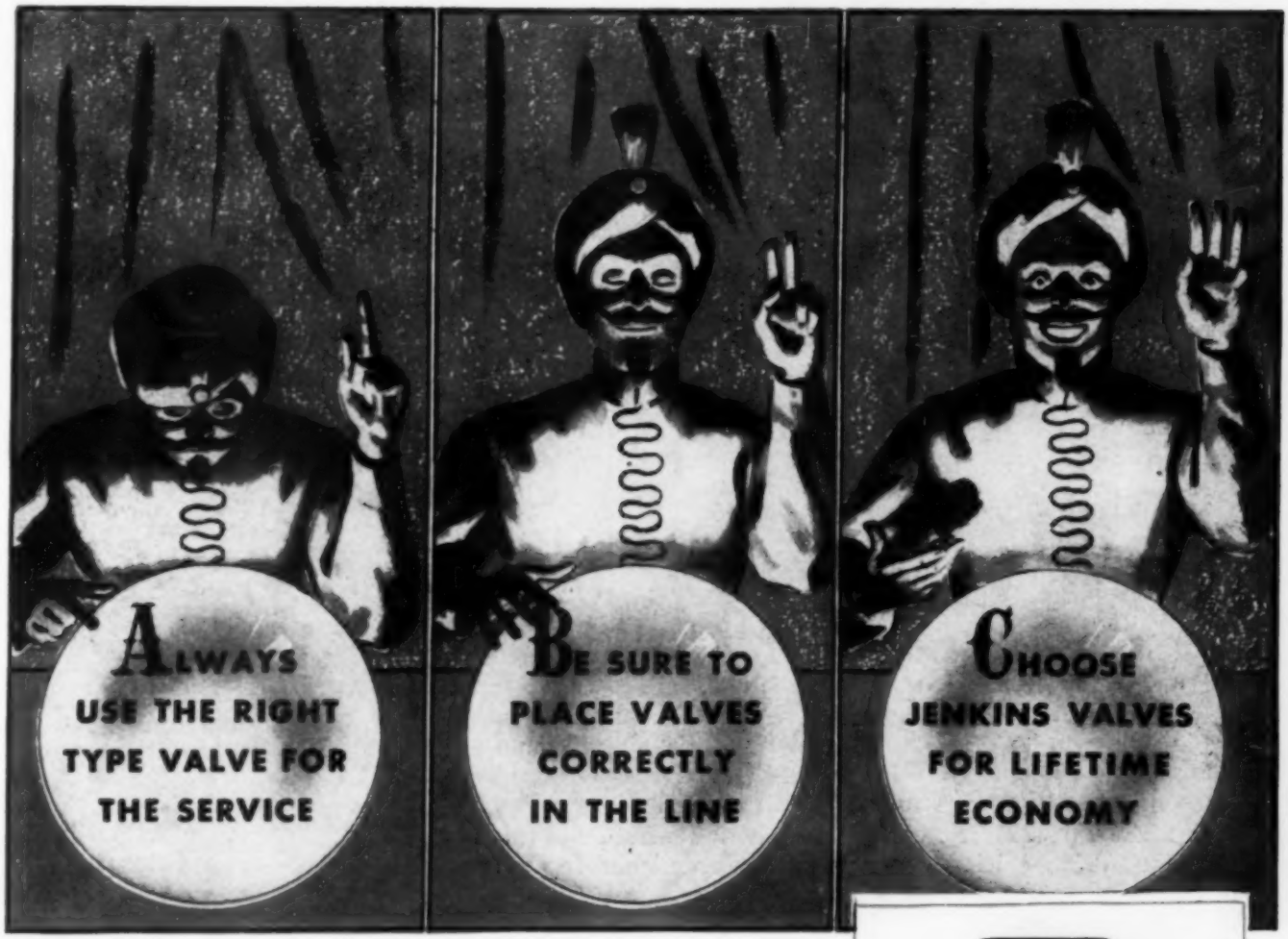
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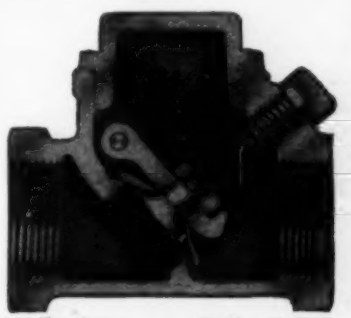

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duced in a continuous still from aldol with acetic acid as catalyst. The polymers of vinyl acetate produced at Hoechst were known as Mowilith and had molecular weights anywhere from 3,500 to 80,000. The various Mowiliths are listed and flowsheets are included which show their preparation. (R. H. Boundy and R. L. Hasche, PB 23741; Jun. 1945; 15 p.; 50¢; P. $1.)

Investigation of German Plastics Plants—Part 2—Part one of this report is PB 949. Part two reports on the investigation of thirteen plants: Dynamit A. G., Troisdorf; I. G. Farbenindustrie, Uerdingen; Dielektra A. G., (Meirowsky & Co.) Porz, near Cologne; Henkel & Cie A. G., Dusseldorf; Lettron Werk Herberts A. G., Wuppertal-Barmen; Bisterfeld & Stolting, Radevormwald, near Wuppertal; I. G. Dormagen; Rheinisch-Westfalisches Kunstatoffwerk G. m.b.H., Ketwig, near Essen; Presswerk A. G., Essen; I. G., Hochst: Chemische Werke Albert, Weisbaden-Biebrich; Kalle & Co. Aktiengesellschaft, Wiesbaden-Biebrich; Rohm & Haas A. G., Darmstadt. (J. H. Rooney and others, PB 25642; Jun. 1945; 307 p.; M, $7; P. $21.)

German Hydrogen Peroxide Industry—Previous surveys of the German hydrogen peroxide industry by several investigating groups have reported on production quantities, plant location and capacities, ownership, personnel, etc. The properties and military applications of peroxide have also been studied. The purpose of the mission which is the subject of this report was, therefore, not to duplicate the work of others but to obtain additional and more specific information with respect to manufacturing processes, equipment and operating procedures. The primary purpose of the mission was to discover if possible any important process developments which had been accomplished in German practice and which would by their adoption improve the processes being used in this country. For this reason highly concentrated peroxide as well as the production of peroxide of normal grades and concentrations were of importance. The targets to be visited were selected after due consideration since it was known that three electrolytic processes and one direct chemical process were in use in Germany. Since the chemical or barium peroxide process was insignificant for this mission, emphasis was placed on the electrolytic processes for basic manufacture and to the processes for producing the concentrated product. The targets investigated and the objects of investigation were:

(1) Degussa, at Rheinfelden
  (a) Production of H_2O_2 by the $H_2S_2O_8$ process.
(2) Elchemie, at Kuefstein, Austria
  (a) Production of H_2O_2 by the $(NH_4)_2S_2O_8$ process.
  (b) Production of concentrated H_2O_2 by the Elchemie method.
(3) Electrochemische Werke, Muenchen, Hollriegelskreuth
  (a) Production of H_2O_2 by the $K_2S_2O_8$ process.
  (b) Production of concentrated H_2O_2 by the EWM method.
(4) Otto Schicker Company, Bad Lauterberg
  (a) Production of H_2O_2 by the $K_2S_2O_8$ process.
  (b) Production of concentrated H_2O_2 by the EWM process as possibly modified for application at this site.

All these processes are used in the United States. Photographs and plans of the various plants and processes illustrate the report. (M. E. Bretschger and others, PB 17331; Apr. 1946; 136 p.; M. $1.50; P. $10.)

Hydrogen Peroxide: Preparation, Practices and Rules of Transport and Storage—The wide military use of hydrogen peroxide in Germany

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"I should think so, Herb Palmer! Managing a few storm windows ought to be easy for a man who's been bragging about working 200 feet above the ground on a wax shower . . ."

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"That's a winch! And why shouldn't I talk about our equipment? If a guy can't boast a little about the company he works for, he'd better get another job."

"Of course, dear. I'm mighty thankful Armstrong supplies such good equipment when you work so far up in the air. But these windows are only on the first floor . . ."

"Still they'd go up a lot faster if I had a decent ladder . . ."

"All right, dear, all right. Maybe you'd better go downtown and get yourself a new ladder. You'll need it next spring, anyway, when you paint the house."

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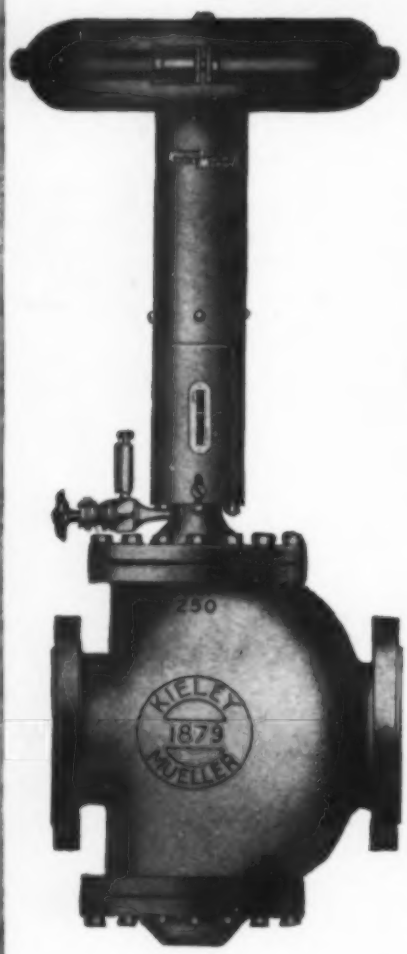

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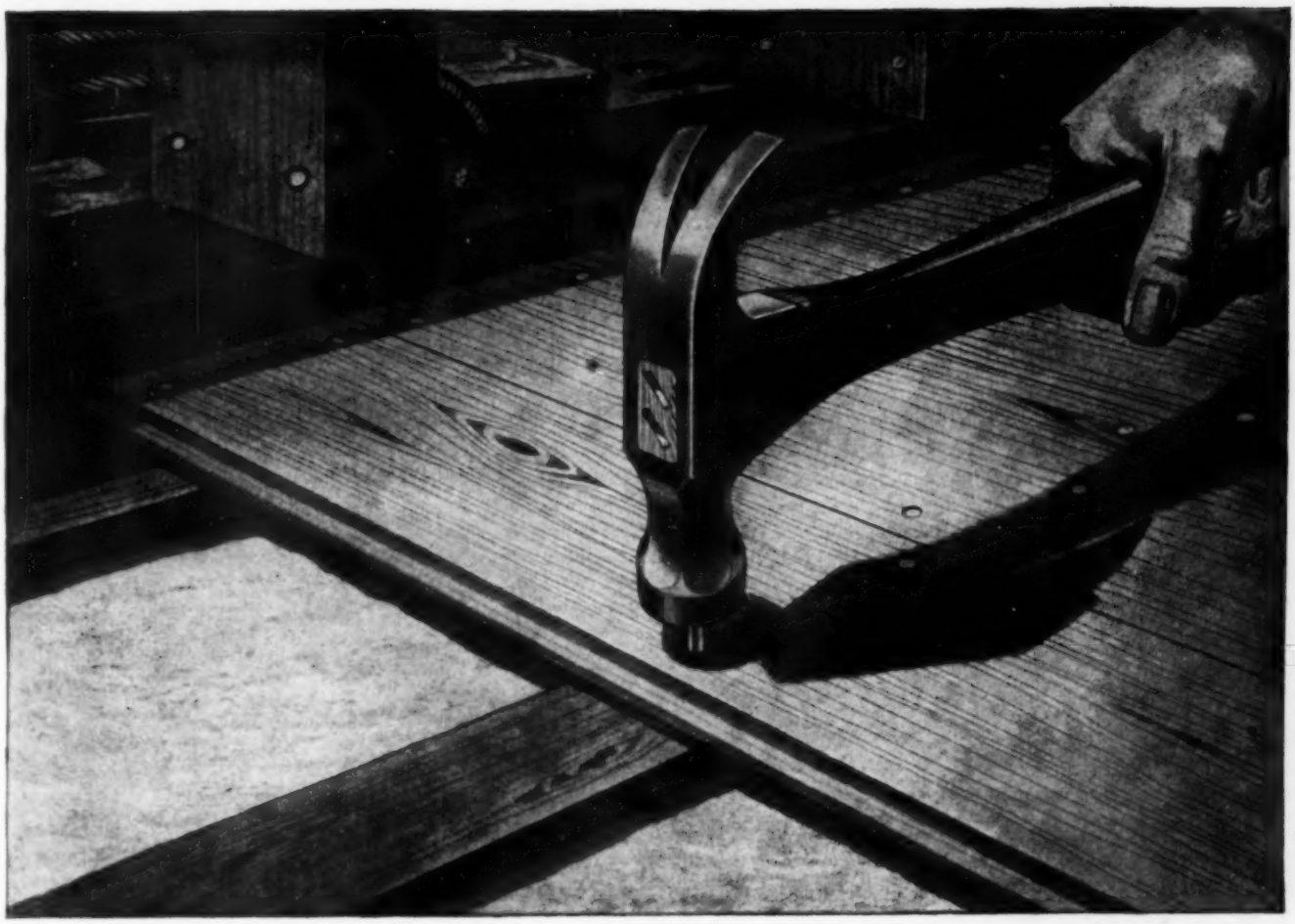
necessitated the construction of a great quantity of storage depots and the wide dissemination of knowledge of this material. Manuals on handling under different conditions were printed, and simplified analytical methods were established. This report attempts to bring together in one report the most recent developments in this field to aid in the possible establishment of similar depots in the United States. (W. G. Gormley and G. W. Morrow, PB 22830; Sept. 1945; 92 p.; M. $1; P. $7.)

Report on Investigations by Fuels and Lubricants Teams at the I. G. Farbenindustrie A. G. Works at Ludwigshafen and Oppau—The Ludwigshafen and Oppau plants are largely independent I. G. factories. The former factory is a general organic chemical works specializing in dyes, dye intermediates, plastics and synthetic rubber, while the latter is a heavy organic chemical factory producing ammonia, methanol, higher alcohols and their derivatives. Before the war much of the I. G. research and development work was carried out at Ludwigshafen; the high pressure research section played a very active part in all hydrogenation developments. Investigation revealed that no large plant for synthetic fuels or lubricants had been operated at this target. Valuable information on synthesis gas production from hydrocarbon gases was obtained as well as interesting data on a number of chemical synthesis. The report presents under the following subject headings the information obtained in the course of various visits: Synthesis gas production, synthesis of ammonia, synthesis of methanol and higher alcohols, hydrogenation and related processes, lubricating oil, Fischer-Tropsch synthesis, miscellaneous chemical production, information on other German factories, I. G.-Japanese Army negotiations, development of Wickel pressure vessels and of high pressure vessels, and a discussion on development of hydrogen resistant steels. Of interest in appendixes are a tabulation of heat exchangers used, cost calculations and a discussion of large scale production of synthetic fertilizers. Diagrams, flowsheets, and tables. (R. Holroyd, PB 23750; Aug. 1945; 133 p.; M. $1.50; P. $9.)

Interview with Dr. Barchfeld—Dr. Barchfeld, chemist at Dynamit A. G., Troisdorf, in working on fillers for phenol resins, developed a method of making fiber boards having various physical properties, from waste fibers without any added binder. It was also found that such boards could be rendered water-repellent by heating to just below the charring point. Data are given on the physical properties of these materials, called Tronal, when prepared in various ways. Information is also given on the preparation, use and properties of Dynal, the phenol-resin-bonded, laminated, paper product made by Dynamit A. G. and used principally for aircraft sheets. The paper used for Dynal had the resin incorporated in it in the paper making process and required no dipping. Limited information was obtained on the use of Tronal as a substitute for balsa wood in aircraft construction. (N. B. Hutcheon, PB 19699; Sept. 1945; 13 p.; M. 50¢; P. $1.)

Report of Combined J.I.O.A. and B.I.O.S. Powder Metallurgy Trip No. 1466—This report reviews the field of powdered metallurgy as carried on in Germany. The information contained in the report was obtained by British and American investigators traveling to the various plants and interrogating men responsible for progress in the powdered metals field. (Gregory J. Comstock and others; PB 19689; 1945; 271 p.; M. $3; P. $19.)

Hydrofluoric Acid—The factory inspected was one of a pair. That at Stulin was designed to make pure HF and KF, and the other at Falkenhagen was designed to make elementary fluorine from these materials by electrolysis, and chlorine trifluoride. When the Russians were



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approaching Berlin much of the equipment from the second factory was stored at Stulin. The layout of the factory and diagrams of the retort and distillation buildings are given. Photographs are included. The hydrofluoric acid was always transferred with compressed air —there were no pumps used. Some particulars of the plant at Falkenhagen are given. The fluorine was made by electrolyzing a molten circulating bath of KHF_2. Equipment of the chlorine trifluoride synthesis units is briefly described. The fluoride was said to be made from its elements in two stages at 200 deg. C. and 260-280 deg. C. respectively, over a nickel fluoride catalyst. The converters were made of pure nickel and copper could be used in the condensers. (W. Archer and others, PB 18950; Dec. 1945; 11 p.; M. 50¢; P. $1.)

German Neoprene—This typewritten report in English mainly describes production at Hochst of monovinyl acetylene (MVA), its chlorination to form 2-chloro-1,3-butadiene (chloroprene or CD) and the polymerization of CD to form neoprene. Chloroprene and neoprene were considered by some German investigation to be superior in some respects to buna. However, plant rivalries and buna commitments limited neoprene production to pilot plant size and development. Flowsheets show the various steps in the production of MVA from acetylene and the chlorination of MVA to form CD. In the chlorination process only about 20 percent MVA used was chlorinated in one pass, so as to limit formation of by-products. A high boiling oil was removed as soon as it formed since it helped convert CD to dichlorobutylene. The gases were also treated to obtain additional CD. A formula for the polymerization at Hochst is given and the polymerization process described. Not much work was done in Germany on stabilizers for neoprene. Experiments to produce good copolymers with chloroprene were not successful. Neoprene though was found to "weld" very well and was recommended for tire carcasses. Germans impregnated paper to make a good synthetic leather substitute. Curing bags for rubber tires made of neoprene lasted twice as long as natural rubber curing bags. Neoprene was also used for gaskets, packing, the cementing of rubbers, for coating metals, textile fibers and textile coating. Bibliography. (M. A. Youker and N. A. Copeland, PB 19857; Jan. 1946; 374 p.; M. $4; P. $25.)

Manufacture of Porous Stones Used in Walter Hydrogen Peroxide Catalyst—The German Walter (M.P. 14) catalyst for contact decomposition of 80-85 percent hydrogen peroxide consists of a highly porous porcelain stone impregnated with catalyst compounds. The stones or catalyst carrier must combine a high specific area with physical strength necessary to prevent crumbling under service conditions. The stones were developed by the F. Thomas Porzellan-Fabrik, of Marktredwitz near Bayreuth, a branch of Rosenthal Porzellan A. G. This report covers the preparation of this porous porcelain catalyst carrier, including the basic preparation of the porcelain slip, and the special process developed to give the desired porosity. (R. A. Finkel, PB 23101; Sep. 1945; 7 p.; M. 50¢; P. $1.)

A Survey of the Soda Ash and Caustic Soda Plants of Western and Southern Germany—Six German plants were visited. These were: (1) Kali-Chemie plant at Heilbronn, soda ash; (2) Deutsche Solvay-Werke at Wyklen, soda ash; (3) I. G. Farbenindustrie plant, Oppau, soda ash and NH_4Cl; (4) Deutsche Solvay-Werke at Rheinberg, NaOH; (5) Chemische Fabrik Koeln-Kalkat, Cologne, caustic soda; (6) Matthes & Weber plant at Duisburg, caustic soda and soda ash. A description of each plant's processes is given as well as analysis of products. (Z. G. Deutsch and Joseph Neubauer, PB 27434; Nov. 1945; 27 p.; M. $1; P. $2.)

CORROSION FORUM

EDMOND C. FETTER, Assistant Editor

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Corrosion of Constructional Materials By Sulphur and Sulphides

JAMES R. WEST

Senior Fellow, Mellon Institute, Pittsburgh, Pa.
(Multiple Fellowship sustained by Texas Gulf Sulphur Co.)

At the instigation of the Texas Gulf Sulphur Co., Dr. West conducted a thorough investigation to determine the present state of knowledge on corrosion by sulphur and sulphides, especially molten sulphur and sulphur vapor. The literature was surveyed and information was solicited from 135 industrial concerns, including both users and producers of constructional materials. This report is a digest of all the information so obtained; most of the information by far has not been published before, but that which has is incorporated here for the sake of completeness.

NEW USES for sulphur and new compounds of sulphur are constantly being sought. Transportation of sulphur in the molten state, vapor phase reactions of sulphur, and the use of sulphur vapor as a medium of heat transfer are all in the wind. But commercial utilization of these and other new developments will depend upon the existence of heat and sulphur resistant constructional materials.

At present, cast iron and steel predominate in commercial usage, not because they are especially resistant, but because they are cheapest. There is no guarantee, however, that more economical materials could not be produced. It may be possible, for instance, to electroplate tantalum on a stainless steel and then anodize the tantalum. If the tantalum layer is dense and impervious sulphur probably would not affect the surface since tantalum sulphide does not form when tantalum pentoxide is heated with sulphur.

That, however, is only one random possibility. There are many others and much exploratory work needs to be done on sulphur-resistant materials for high temperatures. It is the purpose of this report to serve as a starting point for such research by presenting a collection, as complete as possible, of all the information that industry and the literature have to offer on the subject. In addition, the scanty information that was forthcoming on solutions of sulphur and sulphides was collected, and this appears here at the end of the metal-by-metal discussion of corrosion by sulphur itself.

Compilation of Quantitative Data on Corrosion of Metals by Molten Sulphur

THE QUANTITATIVE data concerning the corrosion of some of the metals by sulphur are assembled and shown in the adjoining chart. The data for each material have been numbered on the graph and a key to these numbers accompanies the chart. Since corrosion rates for only one (or at the most two) temperatures were available for many of the metals, it was felt unwise to draw any curves connecting the data. The variation of the corrosion rate with temperature for each substance may be found by looking for the same number and referring to the key. For example, No. 5 on the chart appears at 260, 500, 565, 690, 770, and 835 deg. F., and from the key it is learned that No. 5 is stainless Type 304.

Inspection of the chart at 260 deg. F. shows that Ni-Resist corrodes at ten times the rate of stainless Type 304; copper plus 10 percent manganese, at ten times that of Ni-Resist; and copper, 3,000 times as fast as stainless Type 304.

Unfortunately the data on the materials at temperatures other than 260 deg. F. are incomplete. However, some observations can be made and the following comparisons are offered on the best and the worst of the materials from the corrosion viewpoint at each temperature: (1) Ni-Resist corrodes at approximately 42 times the rate of stainless Type 304 at 500 deg. F. (2) At 565 deg. F. Ni-Resist disappears about 264 times as fast as stainless Type 304. (3) The relative corrosion rates of nickel and Inconel are 27 to 1 at 665 deg. F. (4) The nickel to Type 304 corrosion rate ratio is 40 to 1 at 690 deg. F. (5) Copper has been found to corrode about 840 times as fast as manganese at 755 deg. F. (6) At 835 deg. F. Monel corrodes at about 35 times the rate of Inconel.

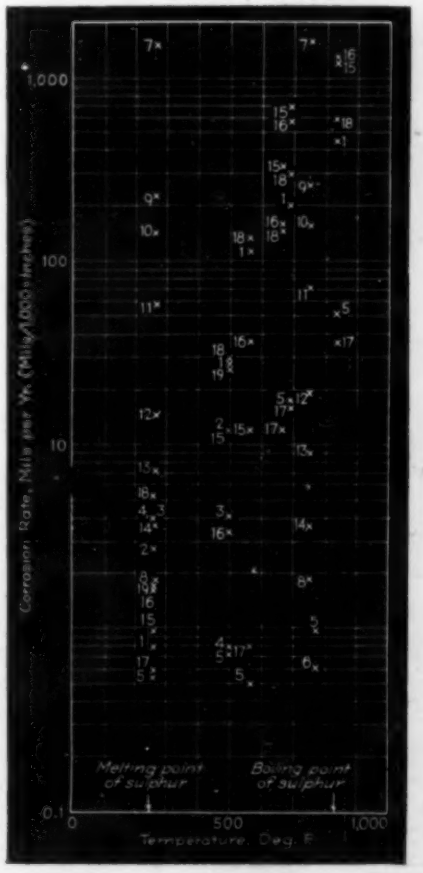
Key:

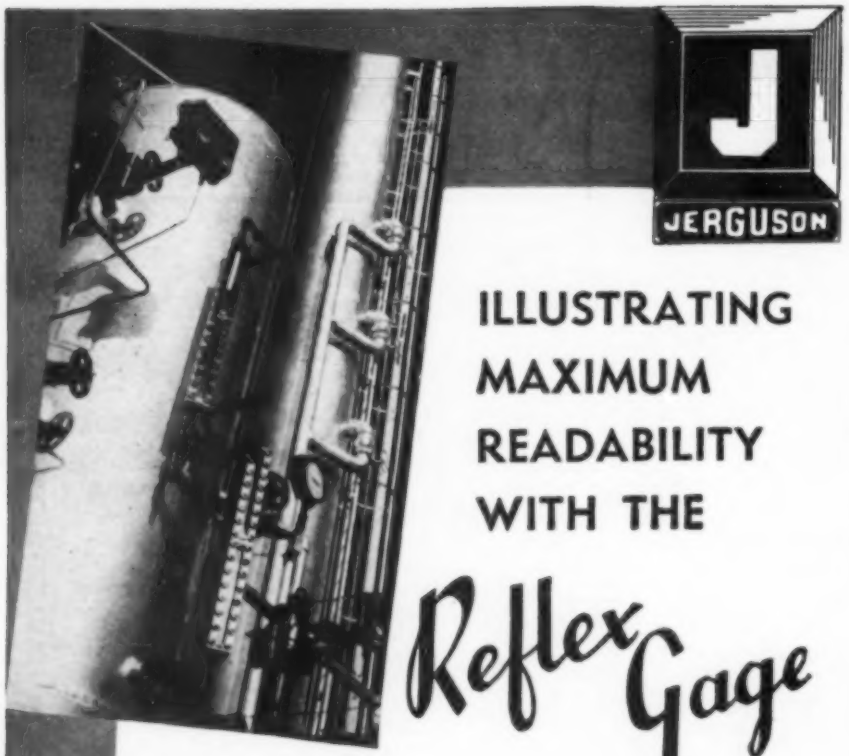
1. Cast iron
2. Mild steel
3. Stainless Type 410
4. Stainless Type 430
5. Stainless Type 304
6. Hastelloy C
7. Copper
8. Manganese
9. Copper + 2% manganese
10. Copper + 5% manganese
11. Copper + 10% manganese
12. Copper + 33.3% manganese
13. Copper + 80% manganese
14. Copper + 90% manganese
15. Nickel
16. Monel
17. Inconel
18. Ni-Resist
19. "K" Monel

ALUMINUM

All authorities agree that sulphur in liquid or vapor form does not attack aluminum. For example, laboratory data show that aluminum is not attacked by sulphur at 410 deg. F. or 770 deg. F. Aluminum has occasionally been recommended by its manufacturers for handling molten sulphur and sulphur vapor, and all reports on the resulting installations have been favorable. In a short trial, aluminum freight cars were used to transport sulphur and sulphur-bearing ores and coals without revealing appreciable corrosion while ordinary freight cars showed great wear by corrosion.

As the cost of aluminum decreases, it should be used more frequently in the handling of sulphur (e.g., pipelines and railroad cars), although it must be cau-





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tioned that aluminum containing sulphur-corrodible impurities is susceptible to corrosion by sulphur and is not suitable for such uses. While boiling sulphur has no effect on aluminum, the low melting point (1,218 deg. F.) of the latter renders it unusable for sulphur boilers and the like.

CAST IRON AND CARBON STEEL

The action of sulphur on steel is quite responsive to moisture, aeration, and temperature. Where all three of these factors are favorable—that is, where the molten sulphur is dry, unaerated, and at low temperature—steel and cast iron are suitable; but if any one of the three factors is unfavorable, excessive corrosion results.

Satisfactory service from iron and steel is recorded in a number of cases. Cast iron pump parts were found suitable where operated submerged in molten sulphur at temperatures up to 350 deg. F.; the original cast iron seats in these pumps failed after eight months service, but the new stainless Type 312 seats failed in only a week so that cast iron was again employed.

Liquid sulphur has been safely handled in tanks made of boiler-plate steel. The 1½-mile-long main sulphur lines at the mines of the Texas Gulf Sulphur Co. are standard black pipe, now twelve years old and apparently good for another twelve; their long life is attributed to the fact that no air, steam, or moisture is permitted to enter them.

The effect of moisture in promoting corrosion of mild steel and cast iron by sulphur is very pronounced and well established. Exposure of cast iron and steel specimens to sulphur containing 15 percent water for 134 days at room temperature resulted in almost complete destruction. The generally accepted explanation is that in the presence of moisture sulphur and atmospheric oxygen combine to give rise to the formation of acid. Wet, acid sulphur stored or transported in steel corrodes the latter rapidly even at room temperature, forming ferrous sulphide at points of contact with the steel. Experiments have demonstrated that small amounts of ammonium carbonate added to wet sulphur not only neutralize present acidity, but go a long way toward preventing the future development of acidity in sulphur stock piles. Later tests have brought out that (at 100-132 deg. F. at least) moisture is the controlling factor in the corrosion of steel by sulphur and that the addition of ammonium bicarbonate materially reduces the amount of corrosion; thus, at 100 deg. F. (and no ammonium bicarbonate added) corrosion increases from around 1 mil/yr. at 0.5 percent moisture content to 15 mils/yr. at 6.4 percent moisture and around 400 mils/yr. at 20 percent moisture. As to the value of adding ammonium bicarbonate, tests have indicated that at the lower moisture contents (under 5 percent) there is little point in adding more than 0.5 lb. per ton of sulphur, but at 20 percent moisture 0.5 lb./ton does little good, while the addition of 50 lb./ton reduces the corrosion rate to from ¼ to 1/15 of the value where none was added.

As to the effect of aeration, both experiment and experience show it to acceler-

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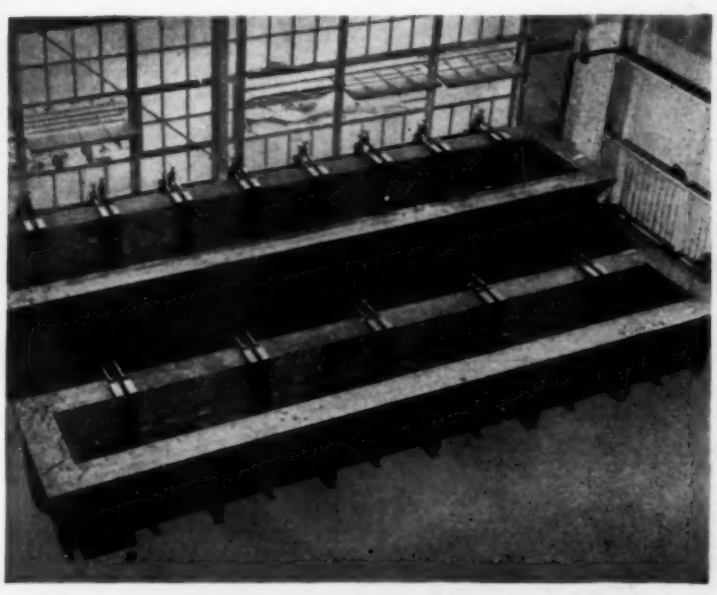

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ate corrosion of iron and steel by sulphur. Thus, in one series of tests in molten sulphur at 260 deg. F., aeration increased the corrosion rate of cast iron from 8 mils/yr. to 45 mils/yr., and mild steel from 3 mils/yr. to 47 mils/yr. Also, it has been found in practice that cast iron and steel equipment handling liquid sulphur with otherwise reasonable maintenance suffers excessive attack at the liquid level.

The influence of temperature was demonstrated strikingly in a series of tests on cast iron in liquid sulphur at various temperatures; the corrosion rate rose steadily from less than 1 mil/yr. at 260 deg. F., through 27 mils/yr. at 500 deg. F., to over 400 mils/yr. at 830 deg. F. Steel would undoubtedly follow a similar course, and one test is recorded where boiler steel was destroyed by exposure to sulphur vapors at 1,300 deg. F. However, it is possible to raise the temperature limit for steel by surface treatment; boiler plate steel metallized with aluminum or chrominum was found satisfactory up to 832 deg. F., and metal-sprayed tubes gave satisfaction in a sulphur condenser in which sulphur vapor entered at 832 deg. F. and in which cooling water entered at 80 and left at 190 deg. F.

In summary, then, plain cast iron and mild steel may be used to handle solid and liquid sulphur at temperatures up to 350-400 deg. F., provided air is excluded from the liquid and moisture from the solid. However, the temperature limit may be raised to 830 deg. F. by metallizing with Cr or Al and the ill effects of moisture relieved by the addition of ammonium bicarbonate to the solid sulphur.

CERAMICS, FUSED SILICA

It is reported that chemical stoneware in the usual applications is not heated above 300 deg. F. and that, under these conditions, such stoneware is not attacked by sulphur, sulphides, or polysulphides. Nothing more has been reported on the resistance of ceramic products to sulphur corrosion, except that sulphur attacks vitreous silica at about 1,830 deg. F. At lower temperatures silica shows toward sulphur its characteristic tendency to be rather inert.

CHROMIUM

Experience has disclosed that sulphur and sulphides do not have an appreciable effect on chromium. A great deal of chromium-plated equipment is installed under conditions where it is subjected to the action of elementary sulphur, or sulphides, both plain and in aqueous solution, and at various temperatures, and in all cases the chromium has performed with commercial satisfaction. It is regrettable, however, that no quantitative data have been recorded on the rate of attack or non-attack by such compounds.

COPPER, COPPER ALLOYS

Copper itself is completely unfit for use in handling sulphur; there is on record one case where the corrosion rate in five hours in molten sulphur at 284 deg. F. was 1.52 i.p.y., and another where a copper rod $\frac{1}{4}$ in.

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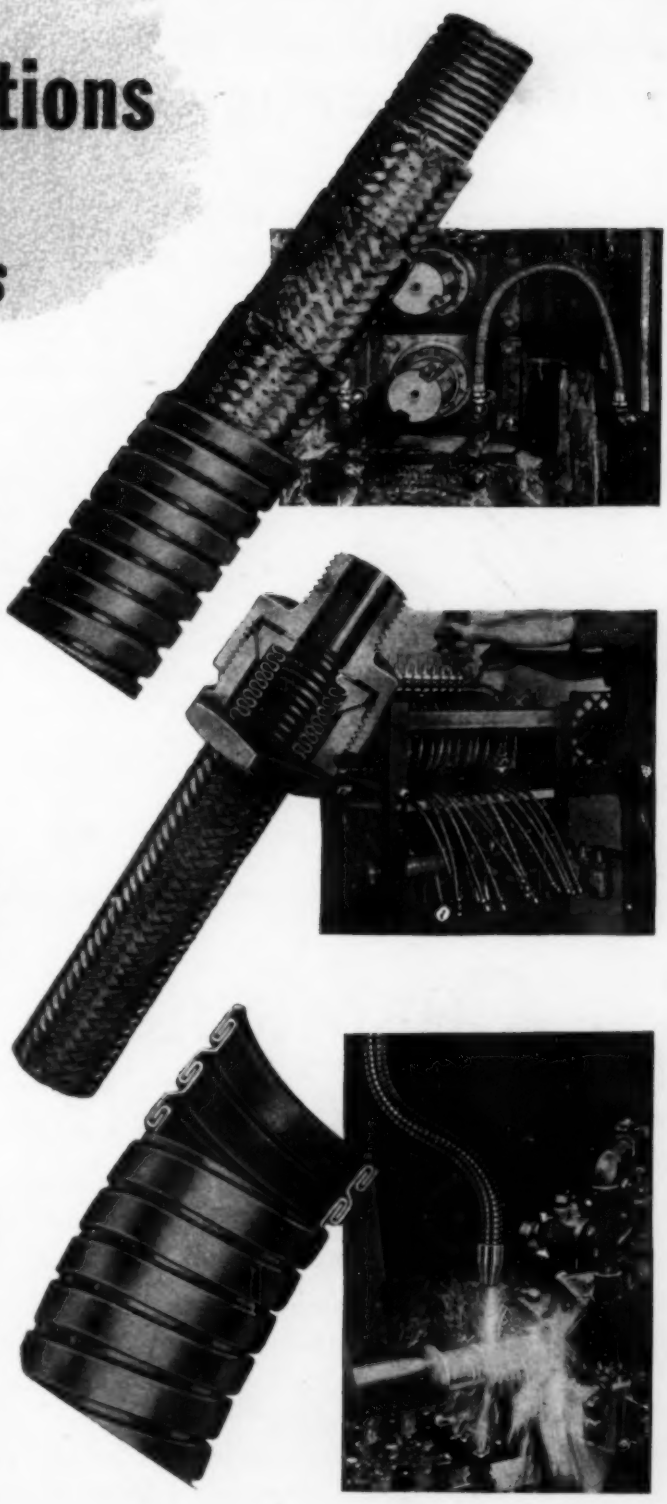

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in dia. was dissolved completely in boiling sulphur in four hours—a rate of 322 i.p.y.

Copper alloys are a lot better than copper itself, but they still leave much to be desired. It is reported that molten sulphur at 266-284 deg. F., after one month, had tarnished Tobin bronze and had badly corroded brass. In tests conducted at 275 deg. F. red brass and low brass were attacked the least; aluminum bronze, nickel silver, and Muntz metal were almost as good; and Admiralty metal, aluminum brass, and silicon bronze were next in order. All were quite resistant compared to copper.

In some experimental copper alloys, the addition of 2 percent tin halved the corrosion rate at 266 deg. F. and 5 percent decreased the rate to one third. Zinc proved even better; the same relative amounts as tin cut the corrosion rate to approximately one fourth and one tenth respectively. Two percent manganese decreased the rate to one seventh, and 5 percent reduced it to one eleventh, making manganese the best of the three. Ten percent manganese lowered the corrosion rate to about one twenty-sixth. At 752 deg. F. the corrosion rate of the manganese alloys increased only slightly over the comparable rate at 266 deg. F.

LEAD

Sulphur reacts rather readily with lead. It is reported that strips of lead take fire in sulphur vapor and burn with a vivid glow to produce lead sulphide. If sulphur is mixed with molten lead the whole mass becomes red hot.

Obviously lead is not a likely candidate for use with sulphur.

MAGNESIUM

Except for its comparatively low melting point (1,203.8 deg. F.) magnesium should be an excellent material for handling molten sulphur and sulphur vapor. The various references on this subject all agree that magnesium is inert to liquid or gaseous sulphur. Depending on economics, this metal should compete with aluminum for handling molten sulphur without corrosion.

MANGANESE

Manganese resists well the attack of sulphur as high as 750 deg. F.; the rate at 750 deg. is no greater than at 270 deg. F. Manganese has been alloyed with copper and these binary alloys have corrosion rates varying from that of manganese to that of copper. The corrosion rate of manganese has been measured as 2 mils/yr. at both 270 and 750 deg. F.; the addition of 10 percent copper doubled the rate at both temperatures, and 20 percent copper raised it to 7 mils/yr. at 270 and 9 mils/yr. at 750 deg. F.

NICKEL, NICKEL ALLOYS

If free access of air is prevented, nickel and Monel are quite resistant to corrosion by molten sulphur at temperatures up to 575 deg. F. Above this temperature their corrosion rates increase sharply. The resistance of Inconel is reported good up to 690

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deg. F. Ni-Resist is no more resistant to corrosion by molten sulphur than plain cast iron. The effect of temperature on corrosion of nickel and its alloys is indicated in the following data. As the temperature of the molten sulphur was raised from 565 to 835 deg. F., the corrosion rate of nickel went from 13 mils/yr. to 1,210 mils/yr.; Monel went from 36 mils/yr. to 1,300 mils/yr.; Inconel, the best of the lot, went from 0.8 mils/yr. to 36 mils/yr.; and Ni-Resist went from 131 mils/yr. to 592 mils/yr.

There was no aeration in these tests; if air is present, all the nickel alloys show higher rates of corrosion at and near the liquid level. No evidence of embrittlement was detected in any of the materials tested.

PLATINUM

Although platinum must be heated to very high temperatures before it reacts with sulphur, reaction has been known to occur during chemical analyses involving ignition, fusion, and evaporation. Because of its high cost, it is unlikely that platinum would be used unless it were absolutely untouched by sulphur and sulphur vapors.

SILVER, SILVER ALLOYS

Silver is quite subject to attack by sulphur. It has been shown that the formation of silver sulphide is more spontaneous than that of the oxide if the partial pressure of sulphur in the air is higher than $(0.6 \text{ to } 33.0) \times 10^{-11}$ mm. Nothing has been reported on any silver alloy resistant to liquid or gaseous sulphur.

STAINLESS STEEL

All the conventional Cr and Cr-Ni stainless steels resist liquid sulphur up to 400 deg. F., though at temperatures that low ordinary steel and cast iron are good enough to put alloy steels at an economic disadvantage. Above 400 deg. F. the stainless steels have better sulphur resistance than unalloyed steels, but there is considerable disagreement as to the exact, and even the comparative, resistance values offered by the several types of Cr and Cr-Ni alloy steels.

It is a fairly general concensus that for service in liquid sulphur up to the boiling point, 17 percent Cr steel or stabilized 18-8 stainless will probably be satisfactory, but that operation at or above the boiling point, as in sulphur boiler tubes, requires higher alloys. For example, titanium-stabilized 18-8 boiler tubes have been reported as failing where, in later tests, a 25-20 Cr-Ni alloy gave indication that it might be satisfactory. For vapor service between the boiling point and about 1,300 deg. F., the controversy centers primarily around the 25-20 Cr-Ni alloy, straight 27 Cr steel, and an alloy containing 27 Cr and 2 or 3 Al. Any of these three could be expected to give adequate service, but no one of them has consistently proved best for all investigators. However, the preponderance of opinion, in point of corrosion resistance alone, seems to favor a high-chrome steel over a chrome-nickel steel, and the Cr-Al steel over straight Cr. Unfortunately, high-chrome steels, and especially the Cr-Al steels, show a tendency

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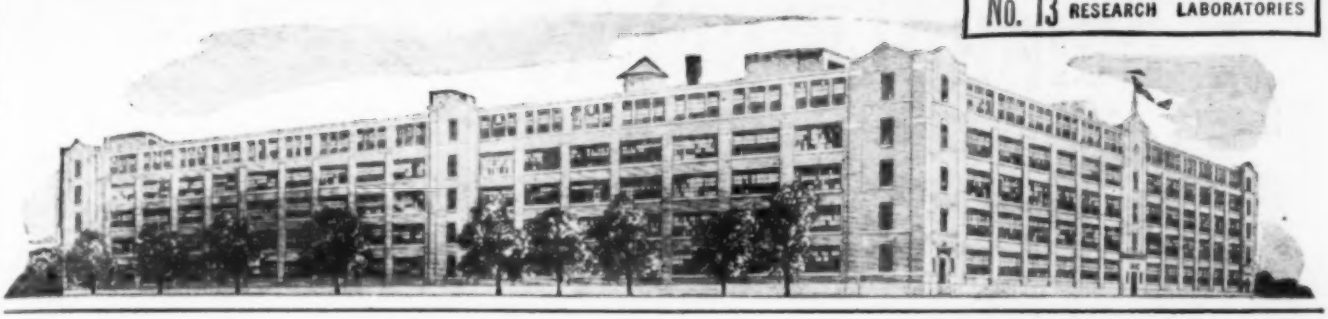

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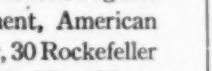
Phenyl biguanide hydrochloride	

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toward increasing brittleness with increasing alloy content.

Although the three steels above are mentioned most frequently for high-temperature resistance to sulphur, there are others that have been propounded. One containing Mo in addition to Cr and Ni and another with Mn and Cb as well as Cr have been recommended. Two rather special alloys, Illium G (21 Cr, 6 Fe, 6 Mo, 4 Cu, W, Mn, Si, balance Ni) and Hastelloy C (58 Ni, 17 Mo, 14 Cr, 6 Fe, 5 W) have shown up well in tests.

Experimental alloys—Al, Cr, Mn, V, Mo, W, and Cu have been added singly to iron in quantity sufficient to form a solid solution with the iron, and the resistance to sulphur at high temperatures studied. Resistance was increased by Al, Cr, or Mn, while V or Mo decreased it. A small amount of W increased resistance but large amounts decreased it. Copper, strangely, had no marked effect.

Another investigation was concerned with the temperature range 1,300 to 1,830 deg. F. and with an alloy containing 61 Ni, 15 Cr, 20 Fe, and 4 Mn with addition of 0, 5, 10, and 15 percent Al. Loss in weight from sulphur attack was measured as a function of temperature and Al content. It revealed that at 1,300 deg. F. Al in quantities up to 15 percent has no effect on the sulphur resistance of this alloy. Above 1,300 the attack is materially lessened as the aluminum content is increased from 0 to 10 percent, and the higher the temperature the more steeply does the corrosion rate descend toward the value for the alloy with 10 percent Al. Increasing the quantity of Al above 10 percent adds nothing to the corrosion resistance.

SULPHIDES IN SOLUTION

Sodium sulphide solutions up to 70 percent concentration and at temperatures up to and including the boiling point have been handled in cast iron and steel equipment, but corrosion is sufficient to result in considerable iron pick-up in the product and in certain items, such as pumps, to involve excessive maintenance. The more concentrated solutions are more corrosive, and the attack is accelerated by increase in temperature. Rather extensive laboratory tests, which included results on specimens rotated in boiling solutions at 1,200 r.p.m., indicated that Monel and nickel form a thin adherent coating or film providing adequate protection, and that they are satisfactory for these conditions. Under static conditions Inconel also showed up fairly well but adherence of the coating was less satisfactory. The stainless alloys were less resistant, and carbon steel and cast iron showed rates of attack up to about 120 mil/yr. Surprisingly, in solutions of sodium hydrosulphide, the resistance of the stainless alloys was reversed as compared with the high-nickel alloys, and 18-8

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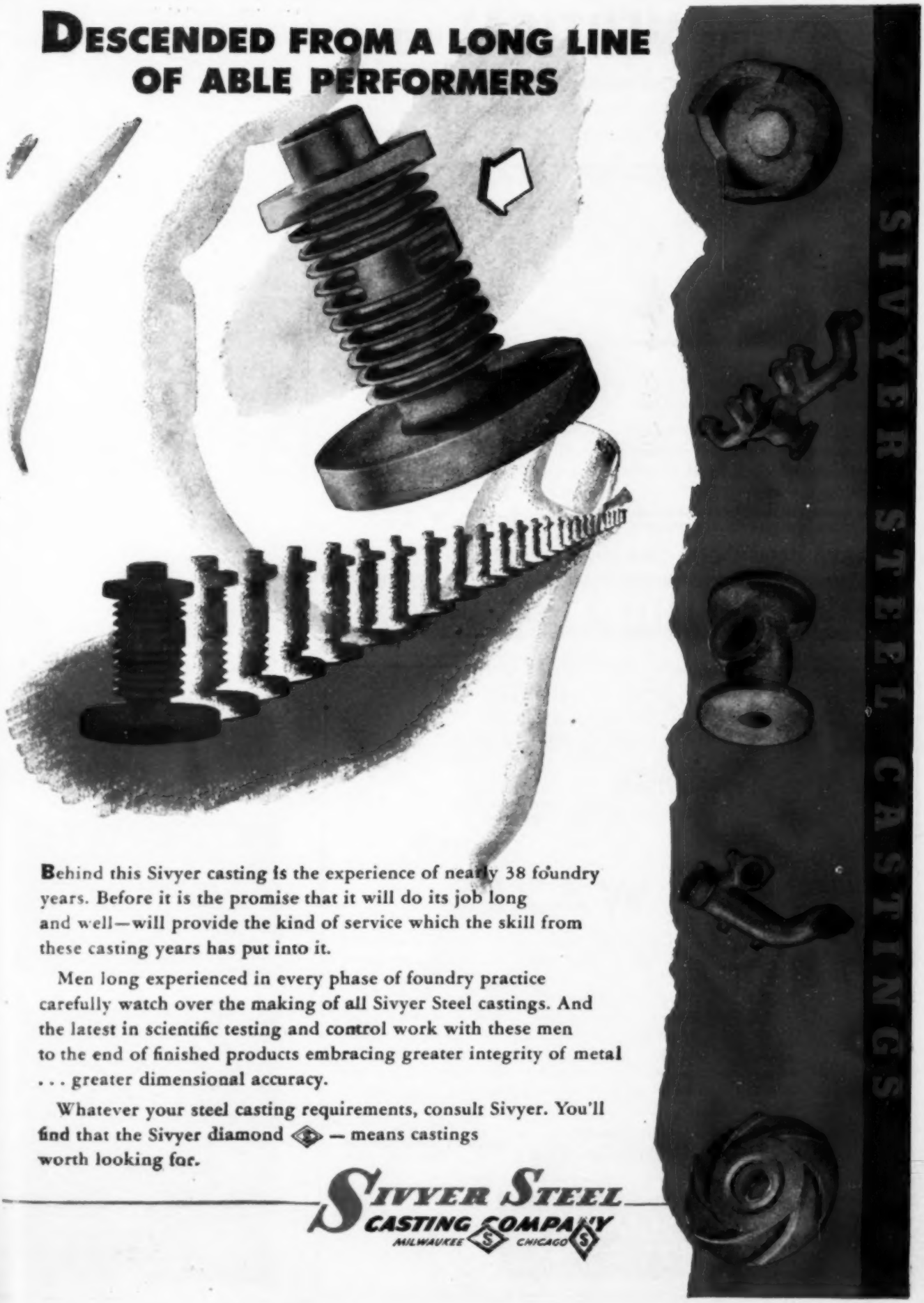

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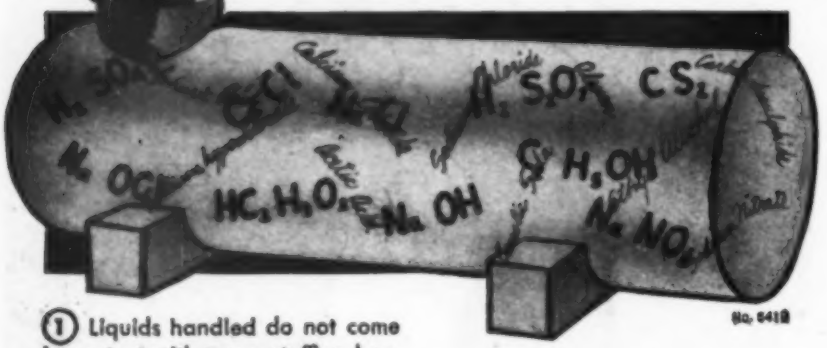

(1) Liquids handled do not come in contact with pump stuffing box.

(2) To compensate for non-lubricating properties of liquid or other chemical solutions pumped, larger bearings are used.

(3) Repacking interruptions are reduced to the lowest minimum.

(4) Damaging vibration is prevented by larger shaft diameters.

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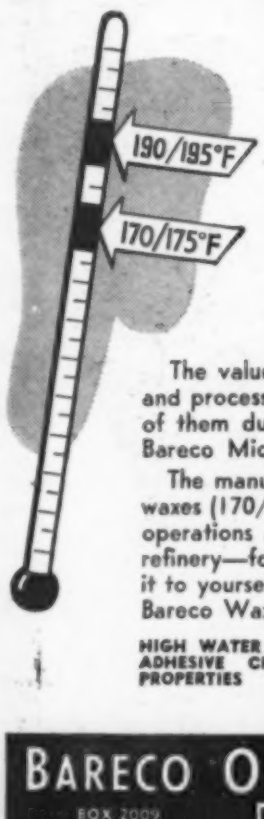

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Samples available in black, white and amber.

was found superior to nickel, Monel, or Inconel.

Other investigators have reported as follows on the stainless steels. (1) A 50-percent-by-weight solution of sodium sulphide at 200 deg. F. attacked Type 410 at the rate of 6.6 mils/yr. and Type 304 not at all; both, however, were corroded by condensation products. (2) A solution of sodium sulphide was evaporated to dryness under vacuum over a period of 21 hr., the maximum temperature being 390 deg. F.; samples of Types 430 and 304 were corroded at the rates of 60 and 50 mils/yr., respectively. (3) It has been reported that Type 310 is being used very successfully for resistance to sulphide solutions, particularly where contamination of the product by iron would be serious. (4) Specimens of Type 304 were exposed in polysulphide solutions under reflux for a period of 16 hr. The corrosion rate for a solution of Na_2S containing 41 percent sulphur was 20 mils/yr.; for a solution of Na_2S_3 containing 58 percent sulphur, 4 mils/yr.; and for a solution of Na_2S_6 containing 78 percent sulphur, 0.3 mils/yr.

In addition to the information given above, there is the report that nickel has been used successfully for the fabrication of evaporators to handle sodium and barium sulphide solutions, and the report that iron and steel have been found satisfactory for the handling of hot caustic sodium sulphide solutions, *provided air was absent.*

Except that magnesium and its alloys are not attacked by ammonium sulphide, no additional information is available on the ordinary commercial metals and alloys, al-

Split 4 and 10-in. pipes from molten sulphur lines. Traces of water vapor and air in former and absence of them in latter made difference between severe corrosion and almost none. Larger pipe is 17 years old.

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—A complete line, including ELLS—TEES—CROSSES—RETURN BENDS—"Y's"—LATERALS—FERRULES—REDUCERS—ADAPTERS

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—a new kind of fitting, bringing even greater benefits from the use of light-gauge tubing, for chemical process industry applications where conveying lines require corrosion-resistant properties.

Fittings are fabricated from type 316 stainless steel. Line connections are made with simple, leak-tight flanged couplings (as illustrated)—designed for working pressures up to 250 lbs. per sq. in. Adapters permit use of TRI-CLOVER fittings with a variety of other types, including IPS fittings, conical glass tubing, and welding fittings..

Available for commercial tolerance stainless steel tubing having outside diameters of 1, 1½, 2, 2½, 3 and 4 inches.

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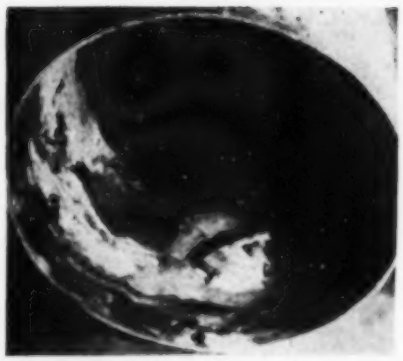


Steel parts from sulphur burner shell. Inlet end, above, subjected to moist solid sulphur in melting zone, is severely corroded. Outlet end, below, shows no corrosion from exposure to dry liquid sulphur

though it is known that certain high-silver alloys have been produced experimentally that are quite resistant to sulphide solutions. There is little likelihood however that any of these silver alloys will replace the present commercial materials. It is quite probable that cast iron and steel will continue to be used to handle sulphide solutions where iron pick-up is not objectionable, and that nickel, Monel, nickel-clad steels, and stainless steels will be used where iron impurity cannot be ignored.

SULPHUR IN SOLUTION

There is very little information available on the corrosive effects of sulphur solutions. Naphtha solutions of sulphur corrode copper, mercury, and silver, but do not react markedly with aluminum, zinc, steel, tin, brass, or chromium. The attack on copper and its alloys by sulphur dissolved in hydrocarbons has been prevented by certain inhibitors. Copper alloys have been shown to be more resistant to chloroform solutions of sulphur than copper itself.

Acknowledgments

The writer is indebted to W. W. Duecker of Texas Gulf Sulphur Co. and to W. A. Hamor and L. H. Cretcher of Mellon Institute for encouragement and good advice in the preparation of this article. Thanks are given to Texas Gulf Sulphur Co. for permission to publish these data. Many industries, too numerous to mention, and the literature have made this compilation possible.

FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN, Engineer

A NIPA PALM provides building material to the Filipinos as well as food, drink, landscaping, and the raw material for the distilling industry, as recorded in the log of Tech. Sgt. Guy Slaughter, one-time interpreter attached to the 1st Nebraska Volunteer Regiment as of 1899. After the fighting had petered out, the unexpended part of the regiment was returned to Nebraska—that is, all but Slaughter and a few buddies who volunteered to remain among the Filipinos and accept a share of the white man's burden. His first assignment was the province of Cagayan. His duty was to control the licensing of the 66 distilleries in his territory and to collect the revenue tax in order to give the boys the feel of citizenship responsibility under the new order. His intercourse was conducted in Spanish with some leading factotum who also knew the local dialect. The boys showed respect for the American uniform and an eagerness to obey the commands of the great white father in Washington.

When a flower stock of the palm is cut off, a sugary sirup oozes out of the stump and this sirup is captured in the ubiquitous half shell of a coconut. From time to time the surface of the bleeding stump is scraped or cut back to encourage maintenance of flow. The accumulated liquor is allowed to ferment and the mash is used as beer for family purposes. The he-man, however, craves more kick per gallon. In order to satisfy his requirements, a still of standard design was evolved by the local technologists with the help of the foundry salesman from the mother country.

The barrel of the still is made out of the trunk of a tree about 30 in. in dia. hollowed out by fire. For the benefit of any chemist who may have retired to Florida and may wish to maintain some extracurricular activity, the apparatus is shown in detail herewith. As can be seen, the low-boiling vapor rising from the mash is condensed against the bottom of the water-filled dome and trickles into the coconut shell whence it flows through the bamboo pipe to the receiving tub. When the mash is exhausted the barrel is hoisted and the stillage is bailed out and replaced with fresh mash.

The capacity of the still under competent attendance was one gallon daily. The aroma of the rum can be varied by the temperature of the condenser, which is dependent upon the rate with which the stillman bails out the warm water. The product can furthermore be refined by rerunning it. However, with men who know their liquor best, the potency of the fusel oil is the prized effect.

Slaughter, thinking to do a service to the industry, fashioned a siphon out of a bent bamboo. When the tribesmen observed the liquor running uphill they fled in terrior of Slaughter's diabolical device. Confidence in him was restored only after his human qualities were revealed through his pathological ministrations in the relief of pain and distress among the children.

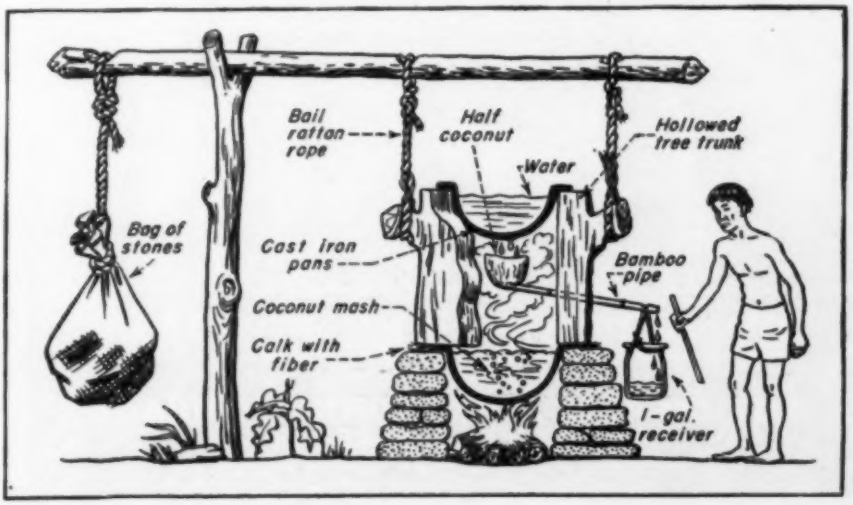
THE STILL OF THE PEON was supplemented by large breweries owned by the plutocrats and these made beer out of rice long before Sgt. Slaughter forsook the Nebraska plow to lift the Spanish yoke. Stills were also provided for essential oils, especially for the extract from the flowers of the ilang-ilang, a liter of which was equal in price to a carload of beer. It was thought to improve the allure of marriageable daughters. On an occasion when a designing matron who commanded respectable Spanish affluence exposed the tall handsome U. S. sergeant, he was immune, being fortunately protected by a cold that affected both his sight and his smell. Besides his heart was in far-off Nebraska!

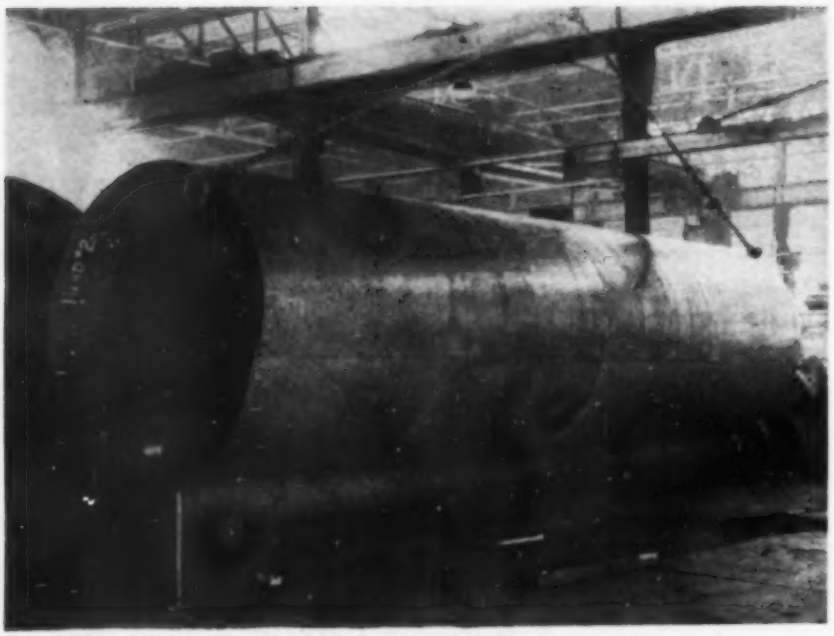
A SHAVETAIL not long out of West Point, was assigned to the inspection of the construction of an outpost house in the hills that came within Slaughter's territory. The government stipulated that the Filipino contractor was to furnish all of the labor and materials but could draw on the quartermaster for tools. The lieutenant in his eagerness to anticipate the needs of the contractor inquired what tools were required. All he could get out of the Filipino was, "tengo bolos suficiente." Interpreter Slaughter came to the rescue, explaining that "tengo" means "I have." The natives for centuries have built their dwellings under benefit of the three b's, bamboo, bejuca and bolo (bamboo, rattan and the knife). The elevated mesa did not produce palm and so the frames are of bamboo tied with rattan and roofed with grass thatch. For ornamental purpose the bolo of the Filipino and the machete of the Mexicano equals the sixshooter of the late big, bad western Americano.

THE FIRST IMPORTANT JOB of engineering construction accomplished by J. F. ("Tadd") Taddiken, now general manager, Honolulu Iron Works, was a steam boiler built over a furnace holed out of the earth in his mother's back yard. It consisted of a kerosene can with a whistling-reed stuck into the bung. He omitted the complication of a feed pump and a safety valve in disregard of ASME standards and so when the water ran low and the fire got beyond control, the boiler exploded.

Tadd, in his youth, was one of those reckless mechanics who seek out the facts by trial and error, and by the grace of the Guardian Angel are spared for subsequen service to human kind. He adopted sugar just as a boy adopts language. Before he acquired the technical understanding of leuconostoc, he knew the smell of it. After pocketing his degree from Tulane in '06, he got a full time job at the Cora Mill in Louisiana where he had previously spent his vacations. He acquired there the fun-

Mountain dew, Philippine style circa 1900. Fermented coconut mash is distilled by means of two hemispherical cast iron pans and hollow tree trunk. Normal position of the Filipino, who has been stood up here to serve as a "measuring stick," is a graceful squat on his haunches; he would like to lie flat but the humid Philippine soil induces bellyache of great severity





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damentals of versatility which is the prerequisite of every plant engineer. He also had opportunity to acquire the "humanities" from the circumstances described by an enthusiastic farmer visitor to the Cora Mill. Said the farmer in a communication to the *Planter*, "Superintendent Ed Triche is not versed in chemistry nor even in the intricacies of overflow, entrainment and inversion but he turns out beautiful sugar. He rules his subordinates by love in pleasant contrast with some high-tempered and pompous individuals who govern by fault finding and intimidation."

MANAGER DUPERU appeared at Bill Stephens's pan just at the important moment when Bill held open the charge valve and concentrated on counting the seconds. Bill was in an awkward spot. He could not return the salute as a slip in the count would mess up the batch in the pan. When the ordeal was over, Bill apologized with the explanation that he was counting the seconds which measured the sirup. Bill wasn't a drinking man and so Duperu couldn't figure it out, but he swore that neither Bill nor any other sugar boiler, dead or alive, could count time with stop watch accuracy. Bill admitted the premise except as to the Crockett pan floor which was probably the only spot on earth where this did not hold true. The fact was that one among the dryer drums several floors below rotated at a speed that produced exactly 80 beats of the knocker per minute and Bill's ear was selectively tuned to this knocker.

CHRISTMAS EVE 1917, the storekeeper requested sugar boiler Bill Stephens to call for a package. Similar packages had been received for a few others. At home Bill found that the package contained an autographed copy of President George Rolph's recently published book on sugar production. Bill appreciated it but attached no special significance to the gift. However shortly thereafter Bill was promoted to a supervisory job. The same experience came to the other recipients of the book. According to the underground, the president had made a study of the characters and aptitudes of the promising young men of the plant. The sending of the book was the signal that their work stood out. In 1943 Bill succeeded as refinery manager.

A WELL KNOWN ENGINEER represented an American construction firm at the bidding for a sugar refinery in Japan about 1918. After making him cool his heels for weeks, the owners announced the award of the contract to his firm. While he was stalling around waiting for confirmation, he was requested to name a price reduction for the omission of the filters which it was stated could be built in Japan to promote home industry. The engineer accordingly employed a few days of synthetic delay and then submitted his price. He deducted only the bare cost of the filters leaving the erection, overhead and profit in his base price. This was accepted. A day later the Japanese made a similar request in respect to the cast iron char processing equipment and the engineer proceeded as before. Then one after another, further requests followed for

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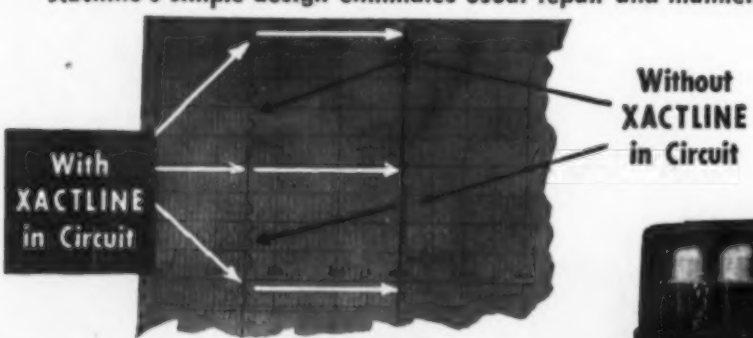

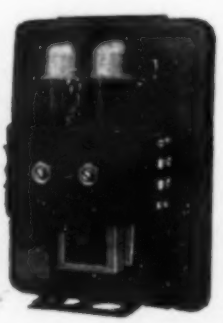

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omission of additional equipment which the Japanese considered themselves capable of building. Finally an agreement was reached. The contract price shrunk considerably and the responsibility for equipment performance was reduced, but the profit account suffered not a whit!

RUDOLPH, the kindly coppersmith, who for many years has maintained the vacuum pans in the refinery, used to bring a sum of money to the engineer's office before Christmas with the request that it be sent to his sister in Germany. In 1930 when she was 82 years old, he requested the clerk to write a letter for him. The clerk inquired if his sister could read English. The answer was, "No, but she can learn."

For years he had an ambition to possess himself of a grandfather's clock like the one at "home" which served as a receptacle for the vital statistics of the family goats. When he had finally overcome the resistance to the extravagance and had accumulated the $184, he picked out his clock at Wanamakers and counted out the money. Then, in his haste to report to his wife what Santa Claus was going to bring, he beat it before his name had been obtained. On Christmas Eve his wife suspected what had happened and Santa just barely got under the wire.

A SHENANIGAN, honestly administered, may sometimes be a useful tool. The engineer's log emphasizes the successes and does not omit the failures from which important values are to be extracted. The superintendent, of revered memory, was a sensitive soul and reference to a failure, with which his department may have been connected, caused him anguish of spirit. He swore a great oath of disapproval of the log. The engineer nevertheless insisted on continuation of the log's complete coverage of all experiences, good and bad, high and low. However, to avoid unhappiness, no more deliveries of the log would be made to the superintendent's office. Then by instructions from the engineer, the chief clerk, a young man of skill and diplomacy, informed the superintendent "confidentially" that he would sneak out a copy "but don't tell the boss as my job is at stake." Thus there was retained the advantage of keeping the superintendent informed without the distress of recrimination and criticism.

IN THE DAYS of prohibition Old Sam acquired proficiency in the production of "white mule" and he wished to extend the benefits to his fellows. His station was the large dusty screen room on the third floor which was off the beaten path. In the 21-in. wall to the east a large fire door covered an opening that had long been closed on the outside with an 8-in. brick wall, leaving a 13-in. recess behind the door for which Sam somehow got the key. In the spookiness of low twelve he fitted this space with shelves and surreptitiously filled it with his product. Business started in a modest way but eventually the path to his station came to the notice of the maintenance engineer. Then one day without notice a maintenance squad chopped off the door and carried it away. Imagine Sam's surprize!

NAMES IN THE NEWS

Sidney D. Kirkpatrick, editor of *Chemical Engineering*, who delivered the commencement address at Clarkson College of Technology on October 20, was awarded an honorary doctorate of science on that occasion.

I. G. Nadel has been appointed to the staff of Manufacturers Research Laboratories, Jersey City, N. J. He was formerly research chemist with the Celanese Corp. of America and chief chemist of Martin Laboratories.

John J. McKetta, Jr., has become assistant professor of chemical engineering at the University of Texas at Austin. Dr. McKetta was formerly in the technical department of Wyandotte Chemical Co. and C. B. Schneible Co.

Martin T. Bennett has opened an office at 917–15th Street, N. W., Washington, for the practice of general industrial engineering.

William W. Niven, Jr., and **George L. Tuer, Jr.,** have joined the technical staff of the Midwest Research Institute in the inorganic and physics sections.

Kenneth O. Beatty, Jr., and **Frederick P. Pike** have been appointed associate professors of chemical engineering at North Carolina State College, Raleigh.

Harold R. Murdock, paper industry consultant of Asheville, N. C., is now in Japan as chief of the pulp and paper branch of the national resources section of General MacArthur's advisory staff.

Arthur L. Fox is now director of the central research laboratory of General Aniline & Film Corp. at Easton, Pa.

Joseph H. Fulmer, formerly connected with the Ethyl Corp. and Sharples Chemicals, has joined the engineering department of Pennsylvania Salt Manufacturing Co.

Reginald Rockwell, assistant general manager of the paper makers chemical department of Hercules Power Co., has been appointed general manager of the department. He succeeds **Ralph B. McKinney,** general manager of the department since 1943, who died September 21.

Jerome C. Hunsaker, of Boston, has been elected a director of the Goodyear Tire & Rubber Co.

R. J. Baumann has joined the market research division of the chemical products department of Standard Oil Co. (Ind.). Mr. Baumann received his master's degree in chemistry from the University of Illinois.

John W. Dersch has been appointed project engineer of the Marietta Works of the American Cyanamid Co., Calco Chemical Division.

Emery Meschter, who has been a group leader in the Du Pont company's Parlin research laboratory of the photo products department, has been appointed laboratory director of the division's laboratory at Towanda, Pa. **Frank E. Swindells,** present laboratory director at Towanda, is being transferred to the Parlin laboratory on special assignment, and **Paul Weiss** has been named to take over Dr. Meschter's work as group leader at Parlin.

W. F. Talbot has resigned as technical director of Sun Chemical Corp., to become director of Stanford Research Institute which is being established at Stanford University, Calif.

Lewis W. Chubb, director of the Westinghouse research laboratories, has been awarded the John Fritz Medal and certificate.

Francis J. Curtis, vice-president of the Monsanto Chemical Co., St. Louis, has been elected chairman of the division of industrial and engineering chemistry of the American Chemical Society for 1946-47. He succeeds **Thomas H. Chilton,** director of the technical division of the engineering department at the E. I. du Pont de Nemours & Co. experimental station in Wilmington, Del.

Melvin F. Wood is now assistant chief engineer of the Du Pont company. He succeeds **Granville M. Read** who became chief engineer with the retirement of **Everett G. Ackart** recently. Mr. Wood has been manager of design division of the engineering department since 1945 and has been with Du Pont since 1928.

E. A. Tice has joined the corrosion engineering section of the development and research division of The International Nickel Co., Inc., at New York, as a corrosion engineer. He was previously associated with Bethlehem Steel in their research department as an engineer in the field of corrosion.

John E. Ashbrook, recent graduate in chemical engineering from Northwestern University, has been named to the staff of Battelle Institute, Columbus, Ohio, where he will be engaged in research in inorganic chemistry.

Frederick W. Smither, chemist at the National Bureau of Standards since 1914 and authority on the analysis of soaps and other detergents, retired on August 31 after 39 years of continuous government service.

E. W. Thompson, who has been manager of the Louisville neoprene synthetic rubber plant, which the Du Pont company built and is operating for the government, has been appointed production manager of the rubber chemical division of the company. He took the position, a new one in the organic chemicals department, October 1.

John L. Gillis, formerly vice president of Johnson & Johnson International, New Brunswick, N. J., has joined Monsanto Chemical Co.

L. L. Hedgepeth, technical assistant to the vice president of Pennsylvania Salt Manufacturing Co., will become executive secretary of the Virginia Water Control Board December 1.

Simon Freed, former assistant chemistry professor at the University of Chicago, has been appointed chief chemist at the Monsanto Clinton Laboratories at Oak Ridge, Tenn.

John D. Rue has been appointed works manager of the Tacoma plant of the Hooker Electrochemical Co.

Victor C. Searle has resigned as research engineer with the E. F. Drew Co., Boonton, N. J., to accept a regular army commission in the CWS. Lt. Col. Searle is assigned to the New York Sub-office of the Office of the Chief, Chemical Warfare Service.

Byrnece Vogt and **Howard Shrut** are now with Calgon, Inc., as research workers on the staff of the detergent division.

Clark E. Jackson, during World War II the assistant laboratory officer of the chemical division at Mare Island Navy Yard industrial laboratory, San Francisco, has joined the technical service department of Turco Products, Inc., Los Angeles.

C. A. Pollard has recently been promoted to assistant general manager of the Richmond, Calif., refinery of Standard Oil of Calif. **C. W. Rehfuss** has been elevated to manager of refining divisions.

David A. Fletcher, former senior plastics chemist at the Du Pont company in Arlington, N. J., has been named associate professor of chemistry at the Pennsylvania College for Women.

Samuel Lenher, manager of the chambers works of the Du Pont company, at Deepwater Point, N. J., has been appointed director of manufacture for the dyestuffs division of the company, a new position in the organic chemicals department.

James R. Reed has been named manager of the commercial research department of

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Walker Penfield, manager of manufacturing of the Pennsylvania Salt Manufacturing Co., has sailed for Europe for a two-month visit of chemical companies in England, France and Denmark.

E. V. Haines has been appointed head of the newly created patent department of International Minerals and Chemical Corp., Chicago, Ill., handling all patents of the research division.

Adalbert Farkas has joined the research staff of the Barrett Division, Allied Chemical and Dye Corp. He was formerly with the Union Oil Co. of Calif.

Frank B. West has returned to the University of Washington as assistant professor of chemical engineering. During the war he was in the Industrial Engineering Laboratory of the Du Pont company, Wilmington, Del.

M. E. Fine and **F. J. Schnettler,** formerly with the Manhattan District Project at Los Alamos, N. M., have become members of the technical staff of the chemical laboratories, Bell Telephone Laboratories, Murray Hill, N. J.

P. P. R. Debye has become a member of the technical staff of the chemical laboratories of Bell Telephone Laboratories, Murray Hill, N. J.

George T. Collins has been appointed manager of the market research department of Pennsylvania Salt Manufacturing Co. Mr. Collins, formerly a chemical engineer in the department, was assistant manager of market research when he was promoted.

George L. Illig has joined the research staff of Calgon, Inc., Pittsburgh.

Lester Kirschbraun, vice president in charge of research of The Flintkote Co., has resigned as an officer of the company. He will, however, continue with the company.

Walter H. C. Rueggeberg, who served during the war as a captain, Chemical Warfare Service, has been released by the Army and has joined the civilian staff of the CWS Technical Command at Edgewood Arsenal, Md. Dr. Rueggeberg is assigned as acting chief, Organic Branch, Chemical Division.

Frank L. Hawkins has returned from a military government assignment in connection with the German chemical industry and has been released by the Army. Lt. Col. Hawkins has returned to his civilian duties at Edgewood Arsenal and has been appointed assistant chief, Design Branch, Plants Division, CWS Technical Command.

Roy S. Hancock, formerly chemical engineer at the Arkansas Ordnance Plant, Little Rock, Ark., has rejoined the staff of the CWS Technical Command, Edgewood

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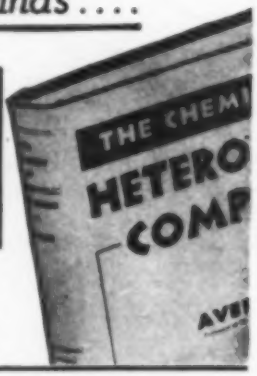

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Arsenal, Md. He has been appointed chief, Operations Branch, Plants Division.

Robert Van Tuyle, for four years in charge of research on fabric coatings for the CWS at MIT has joined Emery Industries, Inc., as director of research on plasticizers, resins and surface coatings. **E. R. Baker** has joined Emery's staff to head the newly created development department and **Don Smith** now directs product research for the candle division.

Gordon B. Zimmerman has joined the firm of Bechtel Bros. McCone Co., San Francisco, as chief process engineer. He had previously been associated for 15 years with Universal Oil Products Co.

C. C. Trump is now associated with Management and Research, Inc., as consulting engineer, specializing in applications of heat and refrigeration to dehydration and other work.

J. N. Forker, general manager of the former tar and chemical division of the Koppers Co., has been appointed general manager of the new tar products division and **Dan M. Rugg** is general manager of the new chemical division.

Robert Lee Von Berg, with the Du Pont company since 1944, has been appointed to the chemical engineering faculty of Cornell University.

J. S. Fluor, Jr., has resigned from his position as executive vice president and general manager of the Fluor Corp., Ltd.

T. S. Carswell, formerly with Monsanto Chemical Co., has joined Commercial Solvents Corp. as manager of the research and development department. **Paul W. Bachman** is now manager of the new technical development division.

Albert H. Cooper has accepted an appointment to the position of head of the department of chemical engineering at Bucknell University.

W. P. Zimmerman has been named executive vice president of the Owens-Corning Fiberglas Corp. **Ben E. Boyd** is now vice president in charge of manufacturing.

I. R. Mockrin, former research engineer with Battelle Memorial Institute, and **W. A. Blum,** recently with the Tennessee Valley Authority, have accepted appointments to the research and development department of Pennsylvania Salt Manufacturing Co. Other additions to the technical staff at Pennsalt's Whitemarsh research laboratories include **W. A. Millsaps** and **A. J. Baldi.**

Henry H. Young and **Price D. Wickersham, Jr.,** have joined the technical staff of the Midwest Research Institute. Their initial association will be the application of chemical engineering and electronics in the Institute's engineering mechanics section.

Edward E. Schultz has joined the engineering staff of Cook Research Laboratories, a

CASE HISTORY No. 9

One in a series of factual experiences of a group of American manufacturers with Multiwall Paper Bags.

COST COMPARISON
(Per Ton)

	200-lb Burlap Bags (Second-hand)	50-lb Paper Bags
Container cost	$1.80	$1.35
Labor cost	.50	.15
Total bag and labor cost	$2.30	$1.50
Saving, paper over fabric		$.80

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LABOR COSTS CUT 70% — A three man crew now packs ten tons an hour. This is *twice* the tonnage that a *five* man crew was able to pack in burlap. Labor cost dropped 70% . . . from 50 cents to 15 cents per ton packed.

TOTAL COST REDUCED — The Cohutta Company reports its per ton cost for burlap bags at $1.80 and for multiwall bags at $1.35 . . . a saving of 45 cents per ton. This, added to the saving in labor costs, results in an overall saving in packaging costs of 80 cents a ton.

(Left) One man operates the St. Regis 107-FC Packer, which simultaneously weighs and fills the 50 lb. multiwall bags.

(Right) Filled bags are easily moved by hand trucks and loaded in freight car.

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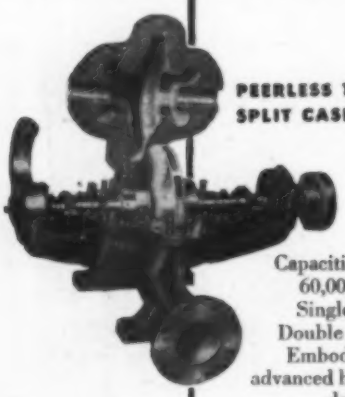

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new division of the Cook Electric Co., Chicago.

Thomas E. Brown has been appointed assistant superintendent of the Bacchus, Utah, plant of Hercules Powder Co.

John W. Greene, formerly in the research division of the Mellon Institute in Pittsburgh and the Standard Oil Co. of Calif., has been appointed head of the department of chemical engineering and professor of chemical engineering at the University of Denver. Other appointments in the department of chemical engineering include those of **James Macdonald** as associate professor of chemical engineering and **Leonard Savory** as instructor in chemical engineering.

Quentin D. Mehrkam, formerly employed as production metallurgist by Thompson Products Co. of Cleveland, has recently joined the metallurgical staff of the Ajax Electric Co., Inc., Philadelphia

George W. Hanneken, vice president in charge of manufacturing of the Standard Oil Co. of Ohio, has retired.

Willis R. Whitney received the first Industrial Research Institute Medal at a dinner on October 17 during the fall meeting of the Institute. Dr. Witney was organizer and first director of the General Electric research laboratory.

Clarence F. Hiskey, former laboratory director for the 43rd Army Chemical Laboratory Co. in Hawaii, has joined the staff of the department of chemistry at the Polytechnic Institute of Brooklyn.

Roberts W. Brokaw, secretary and a director of the Celastic Corp, has resigned. **Benedict Van Voorhis,** manager of procurement for the Du Pont plastic department, will assume Mr. Brokaw's duties with the Celastic Corp., a partly-owned Du Pont subsidiary.

Henry W. Isleib, a Navy veteran who joined Bristol Laboratories, Inc., penicillin division in Syracuse four months ago, has been promoted to the position of head of the chemical extraction department.

John W. Kline has joined the research staff of Calgon, Inc., Pittsburgh.

H. E. Slocum, director of chemical laboratories for the Jones & Laughlin Steel Corp., has retired after 49 years service with the corporation and over 50 years association with the chemical and metallurgical field of the steel industry.

John F. Schnacky, former chemical engineer in the Ansco development section of General Aniline and Film, has joined the Buflovak Equipment Division of Blaw-Knox Co.

Philip H. Groggins has been transferred from Eastern Regional Research Laboratory, Philadelphia, to Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture, Washington. In his new position Mr. Groggins will survey

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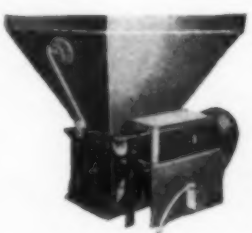

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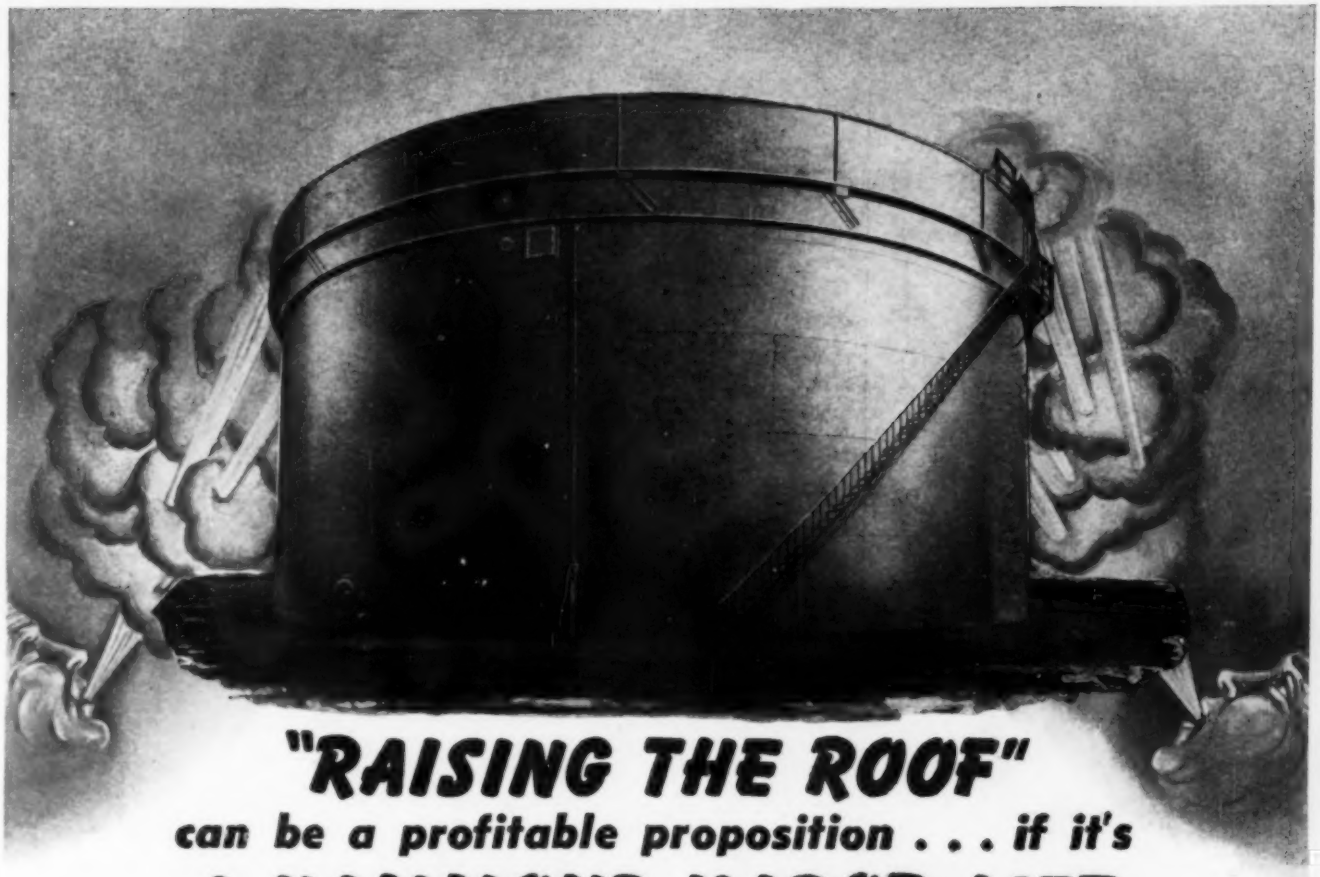

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George E. Holbrook, assistant director of the Jackson laboratory, organic chemicals department, E. I. du Pont de Nemours & Co., Wilmington, Del., has been elected chairman of the American Chemical Society's Delaware Section.

John A. Field has returned to the New York Offices of Carbide and Carbon Chemicals Corp. as a technical representative for the fine chemicals division. Mr. Field has been on leave at the Reconstruction Finance Corp.'s Office of Rubber Reserve in Washington, D. C., for the past two years.

Ward V. Evans received the Honor Scroll of the American Institute of Chemists, Chicago Chapter, on October 4. Dr. Evans is professor of chemistry at Northwestern University.

J. N. Tilley has been appointed departmental engineer for the Grasselli chemicals department of E. I. du Pont de Nemours & Co.

C. K. Bump and **H. W. Mohrman** have been appointed assistant directors of research of the plastics division of Monsanto Chemical Co. Dr. Bump will be in charge of general application and technical service sections, while Mr. Mohrman will head the physics and physical testing sections. The two men were formerly research group leaders.

OBITUARIES

Harry Pulsifer, 67, assistant to the president of American Metal Treating Co., and prominent metallurgical engineer, died in Cleveland, September 1.

Mariano Riveros, 49, general European representative of the Chilean Nitrate and Iodine Sales Corp., died in New York September 1.

Charles N. McNulty, of the staff of the Texas Gulf Sulphur Co., died in New York September 6.

Gilbert E. Seil, 57, nationally known chemist and metallurgist, died in Philadelphia September 11.

Charles W. Seiberling, 85, one of the country's pioneer rubber industrialists, died in Akron September 20.

Ralph B. McKinney, 58, general manager of the paper makers chemical department and member of the board of directors of Hercules Powder Co., died in Wilmington, Del., September 21.

Robert E. Rose, 67, retired director of dyestuffs of technical laboratory, E. I. du Pont de Nemours & Co., died in San Francisco September 23.

Murray Kice, Jr., 53, chief engineer of American Blower Corp., Detroit, died on September 25.

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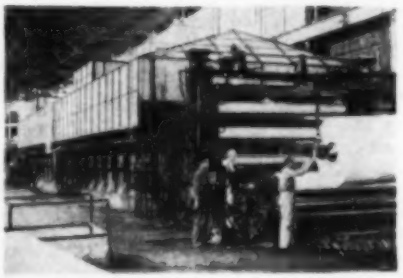

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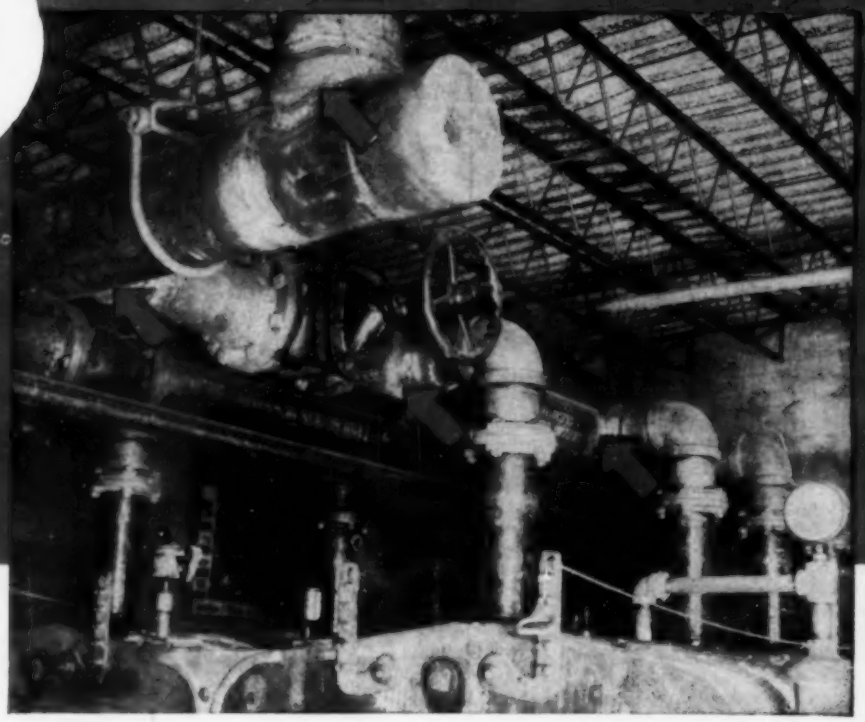

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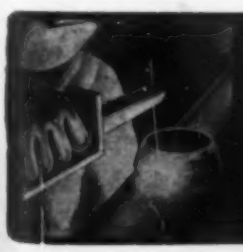

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VERTICAL TURBINE PUMPS

INDUSTRIAL NOTES

United States Rubber Co., New York, has purchased the outstanding common stock of Dispersions Process, Inc. Activities of the subsidiary will be combined with the latex activities of the Naugatuck chemical division.

Monsanto Chemical Co., St. Louis, Mo., has appointed Edmund D. Kennedy sales promotion manager of the plastics division. He will have general supervision over sales promotion activities of the division.

Technical Library Consultants, New York, has established a library research service of special interest to industrial and scientific organizations not having ready access to the wealth of scientific literature in New York.

Allegheny Ludlum Steel Corp., Pittsburgh, has consolidated the sales development and engineering service divisions under the management of W. B. Pierce.

Pennsylvania Flexible Metallic Tubing Co., Philadelphia, has opened a Penflex Sales Co. division office in Syracuse, N. Y. William V. Pyndus is in charge at the new location.

Davison Chemical Corp., Baltimore, has made the following changes in officer personnel: M. C. Roop has been elected treasurer and continues to hold the office of secretary; W. B. McCloskey has been elected controller; J. E. Hardesty assistant secretary and assistant treasurer; and F. J. Griffin assistant controller. Mr. Griffin comes to Davison from the RFC where he has been serving as acting chief, Administration Division, Office of Rubber Reserve.

Allis-Chalmers, Milwaukee, has named Richard F. Muller manager of the New Orleans district office. He succeeds F. W. Stevens who after 41 years of service has requested to be released from this responsibility.

E. I. du Pont de Nemours & Co., Wilmington, has appointed R. C. Weigel as assistant sales manager of the standard products section of the company's ammonia department. George J. Courtney will succeed him as manager at Philadelphia. Louis G. Seebach was recently appointed sales manager of the standard products section, replacing Ewing Hymers, retired.

Conoflow Corp., Philadelphia, has made Donald P. Eckman technical consultant for the company.

Allis-Chalmers, Milwaukee, has named James R. Reed manager of the commercial research department. Other department appointments are those of Jerome F. Fitz-

INDUSTRIAL PLANTS
CHEMICAL PLANTS
FOOD PLANTS
..*Your* PLANT!

THERE IS NO OTHER *Filter* LIKE THIS

The Stainless Steel
KLEIN
IDEAL DIATOMACEOUS EARTH FILTERS AND SLURRY FEEDERS

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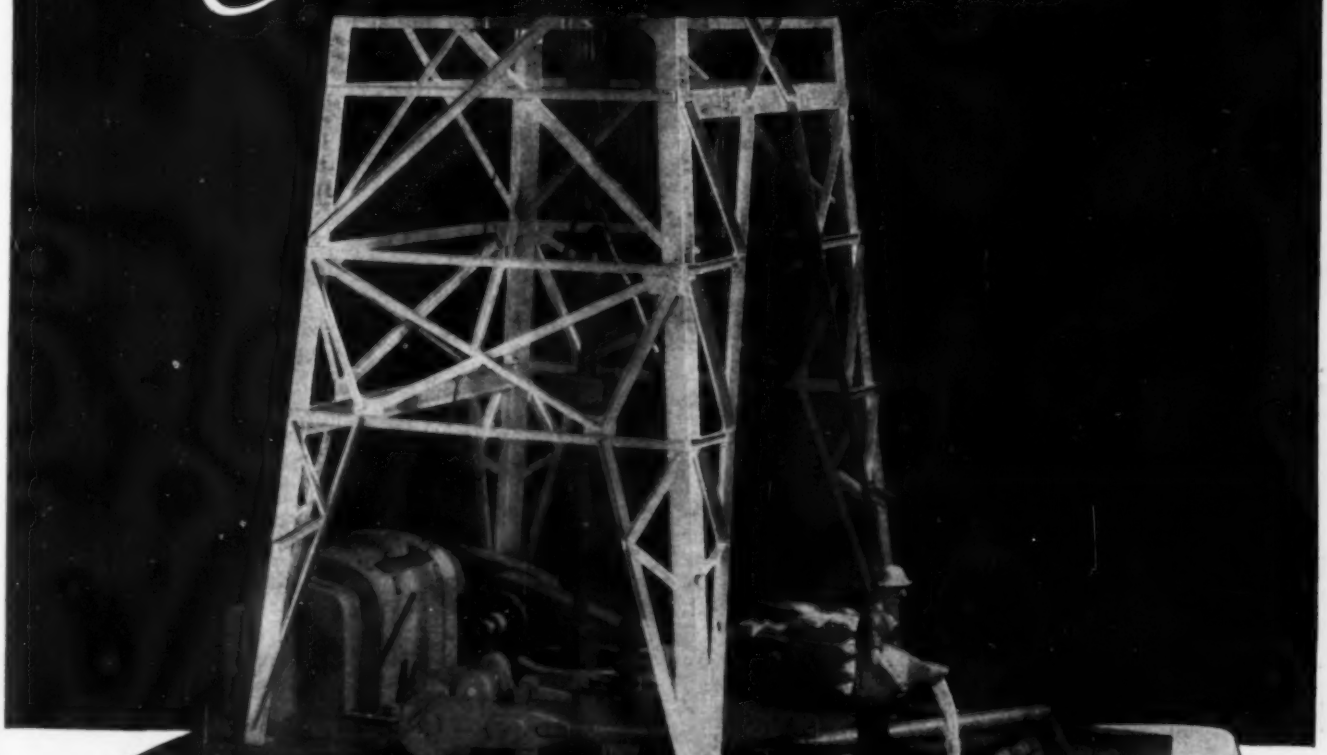
VICTOR *Chemicals*



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In the drilling of oil wells special muds are employed to cool and lubricate the drill bit, prevent cave-ins, hold back tremendous gas pressures and other purposes. Good drill mud must be sufficiently fluid to pump easily, yet capable of building thin, impermeable walls. It should be viscous, yet fluid enough to drop out rock cuttings in the mud pits. To control the viscosity of drill mud, chemicals are usually added . . . sodium phosphates as thinners, powdered ferrophosphorus to increase weight. Both chemicals are produced by Victor. Other Victor chemicals used in oil well drilling and petroleum refining include: **Alkyl Phosphates** (oil additives, stabilizers for gasoline), **Ferrophosphorus** (weighting drill mud), **Phosphoric Acid** (refining oil and gasoline), **Sodium Acid Pyrophosphate, Sodium Tripolyphosphate,** and **Tetrasodium Pyrophosphate** (conditioning drill mud), **Tripotassium Phosphate** (purifying gasoline).

VICTOR CHEMICAL WORKS 141 W. Jackson Blvd., Chicago 4, Ill.
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Plants: NASHVILLE • MT. PLEASANT, TENN. • CHICAGO HEIGHTS, ILL. • VICTOR, FLA.

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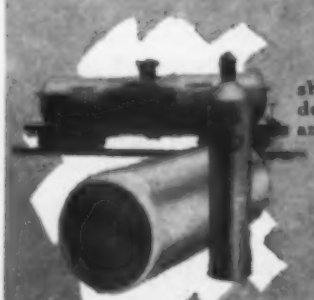

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SALES OFFICES—76 BEAVER ST., NEW YORK 5 :: 131 STATE ST., BOSTON 4

simmons as supervisor in charge of research and Anson J. Bennett, Jr., as supervisor in charge of sales analysis.

Westvaco Chlorine Products Corp., New York, has transferred John deF. Meyler from his position as midwest sales division manager at Chicago to the New York office as assistant manager of sales. W. G. Hodson is now resident manager at Chicago. John M. Richard has been assigned as resident salesman in St. Louis. Arthur F. Smith is resident salesman at Cleveland while Preston F. Tinsley will serve in that capacity in Cincinnati.

Byron Jackson Co., Los Angeles, has acquired the Butte Pump & Motor Works, Chico, Calif. It is contemplated that the business will be expanded and operated as a division of Byron Jackson Co. with no change in name. A. F. Vonnegut has assumed charge as manager, with no other changes in personnel.

American Cyanamid Co., New York, has returned Roland C. Morrison to his prewar post as one of the Calco Chemical Division's New England representatives. Mr. Morrison was recently ordered to inactive duty in the U. S. Naval Reserve.

Graver Tank & Mfg. Co., Inc., East Chicago, Ind., has placed Harold C. Conners and Harold R. Fosnot in charge of sales in the Chicago area. Conners will handle steel plate sales and Fosnot will specialize in water conditioning equipment.

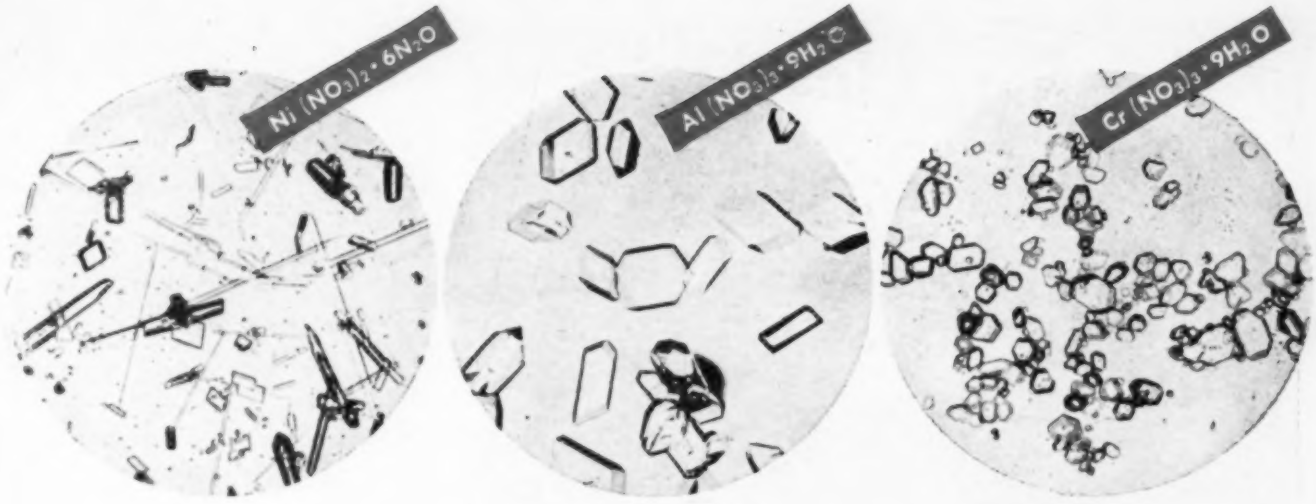
Manufacturers Research Laboratories, Inc., Jersey City, N. J., has formed a new department to service the essential oil, perfume and synthetic aromatic chemical trades.

Commercial Solvents Corp., New York, has appointed William D. Ticknor, Jr., manager of the export division with headquarters in the New York office. Since returning from overseas where he was with the Office of Strategic Services during the war, Mr. Ticknor has been assistant to the vice president in charge of sales.

Timken Roller Bearing Co., Canton, Ohio, has made H. R. McLaren assistant general superintendent of the steel and tube division. J. P. Wargo has become superintendent of tube mills. R. R. Elsasser, until recently manager of the company's Newton Falls, Ohio, plant, is now assistant superintendent of tube mills.

Permutit Co., New York, has acquired the Simplex Valve & Meter Co., Philadelphia. H. W. Foulds succeeds W. H. Roth as president of the newly acquried subsidiary, while Mr. Roth becomes the Simplex board chairman.

Standard Oil Co. (Ind.), Chicago, has promoted C. H. Lamoreaux to the position of assistant general manager of sales for the northern division with headquarters in Chicago. C. C. Smith has been named manager of the Wichita, Kan., sales field. F. M. LeValley has become assistant manager at St. Louis, Mo. Other assignments of assistant managers of sales are L. W.



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From Aluminum to Zinc—whenever your production program calls for one of the Metallic Nitrates, make the Baker & Adamson Division of General Chemical Company your source of supply.

These B & A Fine Chemicals are available in tonnage or other commercial quantities with two grades of most to choose from: *Purified*, for general manufacturing use; *Reagent*, for more exacting requirements.

Into their production goes all of the skill and science Baker & Adamson has gained in 64 years of "setting the pace in chemical purity." That is why B&A Metallic Nitrates are products of highest quality in every grade. That is why you can be sure—and be satisfied—when you specify B&A Metallic Nitrates for your operations.

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LEAD
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Magnesium
Calcium
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and others

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FINE CHEMICALS

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Because B-H No. 1 Cement contains a rust inhibitor which prevents corrosion of metal surfaces, it is excellent for use on flanges, valves, and other fittings. Even if used on cold, slow drying surfaces it forms a firm, rust-free bond.

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Cameron, eastern division; F. J. Swindell, western division; J. W. Ross, central division; and W. C. Kniefel, Rocky Mountain division.

Bryant Heater Co., Cleveland, has appointed Homer A. Size and Arthur X. Nelson as representatives of the industrial division. Mr. Size will represent the division in California and Mr. Nelson, operating Plant Equipment, Inc., will serve the Minneapolis area.

Koppers Co., Pittsburgh, has made Stanley N. Brown, vice president and a director, manager of the new finance department. J. N. Forker, vice president, is the general manager of the new Tar Products Division. D. M. Rugg, vice president, has been named general manager of the new chemical division. W. Reed Morris, vice president, has been named general manager of the new gas and coke division, with headquarters at Kearny, N. J.

Acme-Hamilton Mfg. Corp., Trenton, N. J., is the name of a new company resulting from the merger of the Acme Rubber Mfg. Co. and the Hamilton Rubber Mfg. Corp. Officers of the new company are Albert M. Kahn, president, A. J. Kaminsky, executive vice president and treasurer, Peter Jenkins, vice president, and Charles J. Gale, secretary.

Bechtel Bros. McCone Co., San Francisco, has taken over all Somastic pipe coating operations in the 11 Western States, and in all foreign countries, according to W. E. Waste, president. Somastic plants are maintained at Los Angeles and San Francisco.

Narmco, Inc., San Diego, has established a second resin and plastic operating branch on Pacifific Highway to specialize on plastic applications in the aircraft industry. The firm formerly was known as National Research and Manufacturing Co.

Joshua Hendy Iron Works, Sunnyvale, Calif., has appointed Clifford A. Patch sales manager of the western division. Mr. Patch formerly was chief project engineer at Hendy. In his new duties, he will supervise sale of gears, valves, custom-built machinery and other equipment made at Sunnyvale and Torrance.

Parker Appliance Co., Los Angeles, has announced appointment of Harvey E. Schroeder as manager of the newly created Pacific division of the company.

Permutit Co., New York, has made H. J. Harp sales engineer of internal feedwater treatment for the Philadelphia area. He will make his headquarters in the company's Philadelphia office.

Houdry Process Corp., Wilmington, has moved its New York office to new and larger quarters. The company's new New York headquarters are located at 25 Broad St.

Emery Industries, Inc., Cincinnati, has opened a new and enlarged plant for producing azelaic and palargonic acids. In

A NEW FISHER DIAPHRAGM MOTOR FOR CONTROL VALVES

Type 567 — Reverse Acting Top Work

REVERSE ACTING
AIR OPENED-SPRING CLOSED

FEATURES: *No stuffing box — diaphragm acts as sealing member. Large diaphragm area. Long stroke action. Enclosed spring, separate from pressure chamber. Linear travel relationship to air pressure change. Interchangeable with direct acting Type T Top.*

BOTH WIZARD OR INTERMITTER PILOTS CAN BE INTEGRALLY MOUNTED . . . . .

For field and general service, this top work allows integrally top mounted Wizard Pressure Pilot or Time Cycle Intermitter to be mounted directly on valve. Pilot diaphragm casing assemblies of integrally mounted unit interchangeable with upper diaphragm casing.

APPLICATION

For pneumatic operated control valves where push down to close inner valve construction is desirable, yet operation requires valve air opened, spring closed — close on operating medium failure.

Write for specifications.

Patent applied for

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MARSHALLTOWN, IOWA

THE NEW
REX MACHINE TOOL CONDUIT
TYPE M. T. C.
. . . by CHICAGO METAL HOSE

C.M.H. is proud to present a new product, built in coordination with the Joint Industry Committee of Plant and Electrical Engineers—in cooperation with the National Machine Tool Builders Association.

CHECK THESE OUTSTANDING FEATURES— THEN WRITE US FOR DETAILED INFORMATION

- Flexible metal hose liner
- Synthetic cover
- Extremely flexible
- Smoothness of flexible metal hose bore prevents excessive abrasion
- No detrimental abrasive surfaces throughout hose-fitting assembly
- Liquid-tight externally
- Liquid-tight steel fittings—usable with both standard and water-tight conduit boxes
- Fittings are attachable and re-attachable by user—or can be permanently attached at factory
- Sizes from 3/8-in. I. D. to 1 1/2-in. I. D. inclusive
- Furnished in mill lengths or cut lengths, with factory-attached fittings both re-attachable or permanently attached—or with fittings supplied loose for user to attach.

Write for Bulletin M. T. C.—46

Flexible Metal Hose for Every Industrial Use

CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS
Plants: Maywood and Elgin, Ill.

addition to these products, production of diethylene glycol dipelargonate (X-55) is being resumed on an expanded but still limited scale.

Wyssmont Co., New York, has appointed Kenneth C. Bass, of the Industrial Sales & Equipment Co., to be its representative in the Buffalo territory.

General Detroit Corp., Detroit, has appointed Gail Rutledge to be midwestern regional sales manager. Mr. Rutledge will be located in the company's Chicago branch office. His territory will include Illinois, Wisconsin, Minnesota, and South Dakota.

Calgon, Inc., Pittsburgh, has added two new men to the Banox division field sales staff. J. G. Ripstra will work out of the Detroit office, covering Detroit, Grand Rapids, Chicago, Milwaukee, and other cities in that area. Richard J. Skillman, working out of the Philadelphia office, will cover the eastern seaboard.

Heyden Chemical Corp., New York, has opened a sales and business office at 1700 Walnut St., Philadelphia, Pa.

Pennson Corp., New York, has purchased The McIntyre Co., Newton, Mass. Eben S. Upton, vice-president, and Douglas Sloane, treasurer of the parent corporation, will join R. Louis Towne, general sales manager, and Charles Kester, production manager of The McIntyre Co., as an executive committee which will administer the policies of the combined companies.

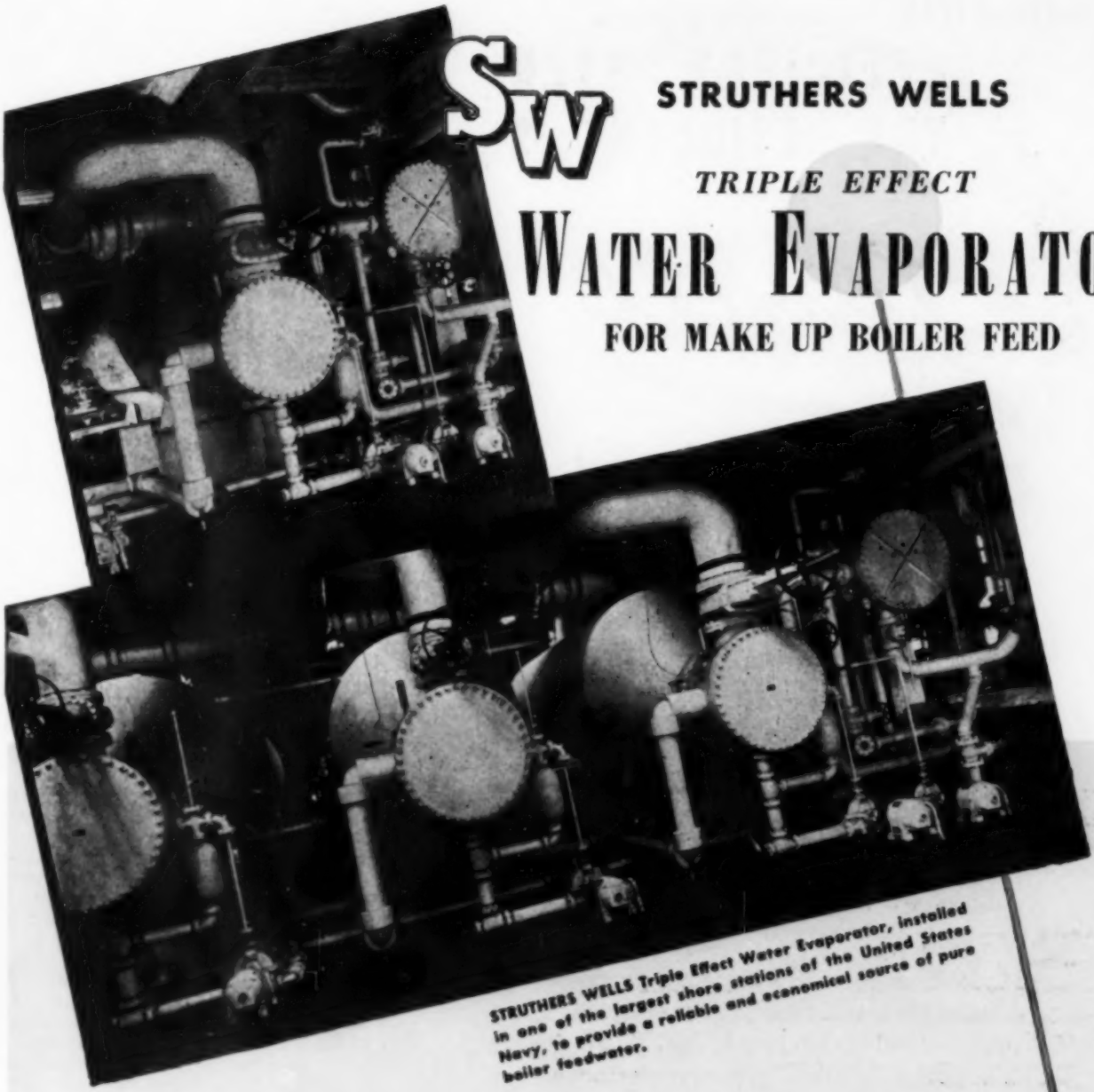
Sun Chemical Corp., New York, has completed the installation of a modern solvent de-oiling unit in the Warwick Wax Co. division, Chanute, Kan., plant.

Aluminum Co. of America, New York, has transferred S. T. Doutt from the Atlantic District sales office to the Tampa office. He is succeeded in the Atlanta office by R. W. Winfree, formerly with Bell Aircraft and the U. S. Coast Guard. The Tampa office operates under the Atlantic District office, which is in the charge of J. H. Irwin.

Dow Chemical Co., Midland, Mich., has made the following additions to its sales staff: John W. Mighton, has joined the magnesium sales staff. He is working in the Midland office on sand and permanent mold casting orders. Ray H. McLeod has joined the cathodic protection sales staff, where he will work in the Chicago office. Howard P. Atkin, has become a member of the cathodic protection sales staff. He will work in the Los Angeles office.

Union Carbide and Carbon Corp., New York, has appointed Bruce A. Gustin, Jr. district manager of the Charlotte office of Carbide and Carbon Chemicals Corp. He recently worked with the Manhattan Engineering District at Oak Ridge.

Goodyear Tire & Rubber Co., Akron, Ohio, has merged three departments in the mechanical goods division as an initial step in a postwar expansion program. E.



STRUTHERS WELLS Triple Effect Water Evaporator, installed in one of the largest shore stations of the United States Navy, to provide a reliable and economical source of pure boiler feedwater.

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TRIPLE EFFECT

WATER EVAPORATOR

FOR MAKE UP BOILER FEED

● Designed to operate on either fresh water or sea water feed, with provision for thermal descaling of tubes, and arranged to permit continued operation with one or more effects cut out, this installation has a normal rated capacity in excess of 100,000 gallons per day of pure distilled water.

In the modern power plant, STRUTHERS WELLS make-up evaporators provide sound basic design together with tried and proven improvements which assure a maximum of performance and a minimum of maintenance, making them fitting companions for STRUTHERS WELLS Feedwater Heaters.

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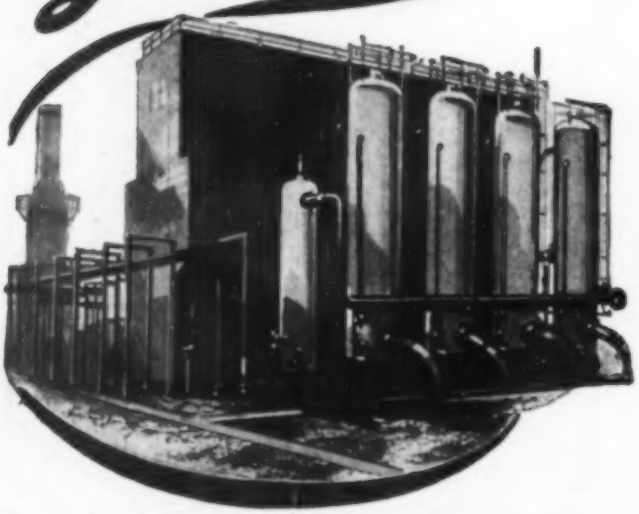
PROCESS EQUIPMENT DIVISION • WARREN, PENNA.

PLANTS AT WARREN, PENNA. and TITUSVILLE, PENNA.

IN THIS
EFFICIENT DRYER
THE DESICCANT IS

Florite*



Natural gas is dehydrated by the use of Florite in this modern plant of an important company operating in the Southwest.

Made from bauxite by special processes of activation and mechanical adaptation, regenerated by heating to 350°F., Florite is superior to other granular desiccants for many and varied industrial uses. Dehydration of natural gas, represented by the illustration above, is one example. Hydrofluoric alkylation of aviation gasoline is a quite special example. Propane, butane, air, nitrogen, carbon dioxide, refrigeration compounds, and various other fluids are successfully and economically treated. Some of these uses have been established for years. New ones are developed from time to time. Correspondence is invited.

*Trade Mark Registered.

FLORIDIN COMPANY, INC.
ADSORBENTS

Room 52, 220 Liberty Street Warren, Pa.

W. Sanders will head the new tank lining and rubber-covered roll section into which the printers' supply department has been integrated.

Kieley & Mueller, Inc., North Bergen, N. J., has appointed Fluid Controls Co., Philadelphia, as representative in the Philadelphia area.

Stearns Magnetic Mfg. Co., Milwaukee, has advanced Frank Brunner to the position of superintendent of the firm's brake factory. Curtis H. Stout has been appointed sales representative to cover the Arkansas territory. Herbert L. Piasecki has been appointed office manager at Milwaukee.

Standard Oil Co. (Indiana), Chicago, has transferred Dwight F. Benton to the post of assistant general manager of the lubricating and sales technical service departments in the Chicago office. He will serve under L. C. Welch, general manager of the departments. W. C. Kniefel has been promoted to the position of assistant general manager of sales for the Rocky Mountain division. W. H. Miller is now manager at Mason City, Iowa.

Graver Tank & Mfg. Co., Inc., East Chicago, Ind., has named Edward B. Heyden to head the construction division of the company. John E. Fogarty has been named to the post of general manager for the firm's Sand Springs, Okla., plant.

Carbide and Carbon Chemicals Corp., New York, has appointed Richard M. Joslin manager of the Detroit office. He will replace George D. Garrett, Jr., Detroit district manager since 1940, who has joined Carbide and Carbon Chemicals Limited, in Toronto, Canada.

Triangle Package Machinery Co., Chicago, has completed the purchase of the assets and business of the Rapp Mfg. Co., Los Angeles, Calif., until recently its West Coast associate. Operations will continue at the same location under the name Triangle Package Machinery Co.

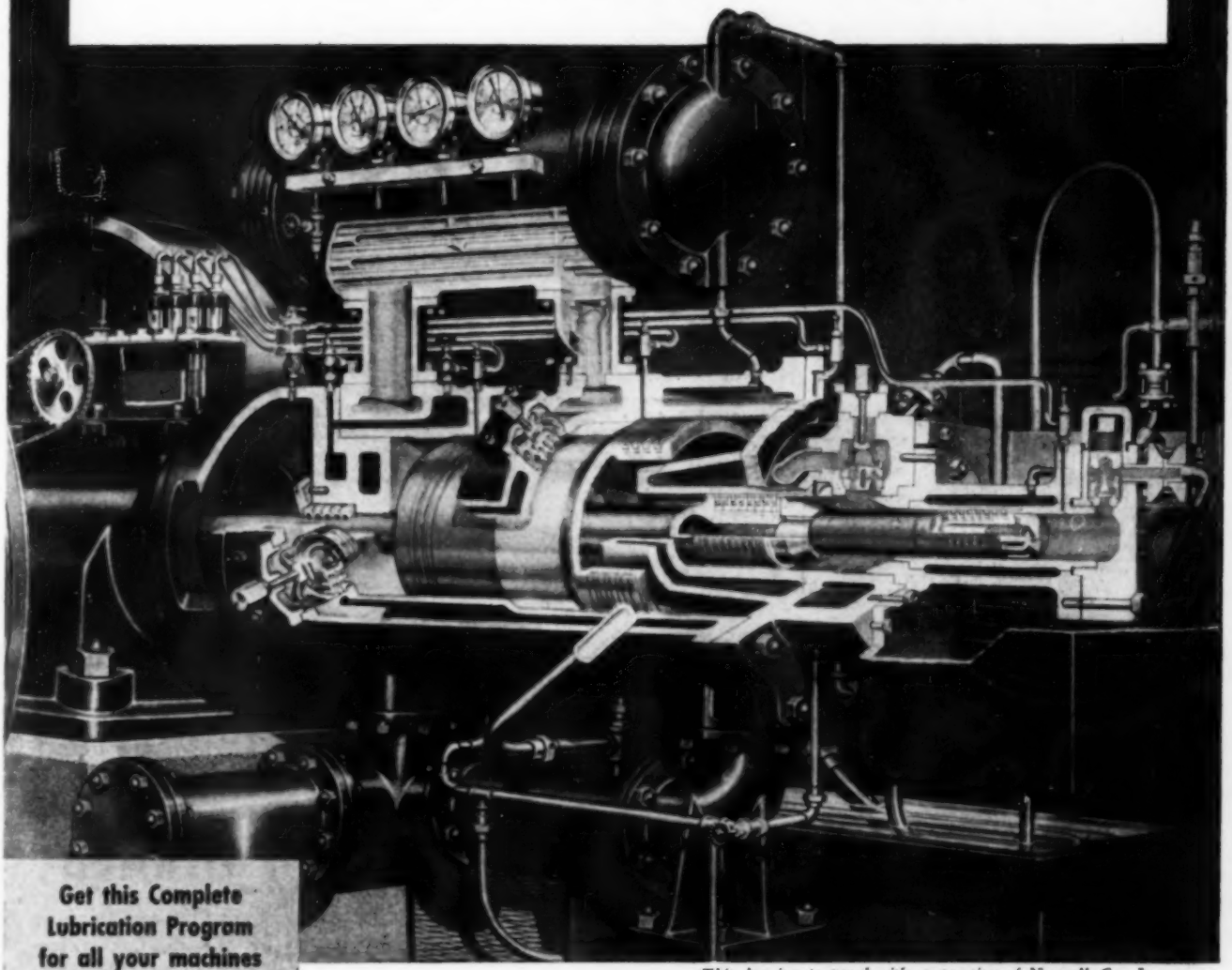
United States Steel Corp., Chicago, has promoted Henry J. Wallace to general manager of sales for the National Tube Co. He succeeds W. F. McConnor, who recently was elected vice president of sales of National Tube.

Midvale Co., Nicetown, Philadelphia, has selected Raymond H. Romig to succeed Herbert H. Moffit as district manager in Washington. Mr. Moffitt retired after long service with the company.

Standard Oil Co. of Calif., San Francisco, has formed a new corporation, The California Refining Co., which plans to acquire an interest in the Barber Asphalt Co.'s refinery and marine terminal near Perth Amboy, N. J.

Kropp Forge Co., Chicago, is now represented in North and South Carolina by Alexander B. Andrews, Jr., with headquarters in the Insurance Bldg., Raleigh, N. C.

New Oil meets high pressures here!



This drawing prepared with cooperation of Norwalk Co., Inc.

THIS multi-stage air compressor sucks in air . . . or gas . . . at low pressures and in four successive steps, squeezes it to pressures of 3,000 lbs. per square in.

The problems of Correct Lubrication mount with the pressures. Here, oil has to protect against wear and seal against blow-by in the face of the rising pressures. It has to fight off the formation of carbon deposits in the heat of compression. And it must stay on the moving parts despite the washing action of condensing moisture.

To do this multiple job, Socony-Vacuum has developed new proved air-compressor oils — Gargoyle D.T.E. 100 Series Oils. These new oils form strong films to reduce wear. They possess high preferential wetting properties to adhere closely to the working parts, and high chemical stability to minimize valve-clogging deposits.

These new oils are available to help keep your air compressor on the job longer with less time out for repairs and replacements.

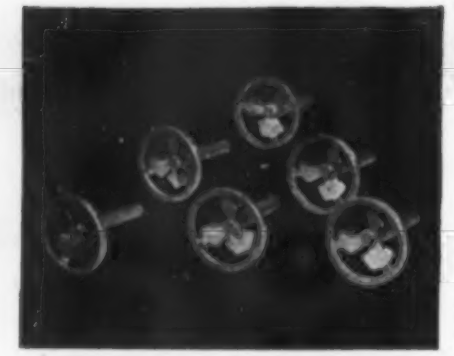
Get this Complete Lubrication Program for all your machines

- Lubrication Study of Your Entire Plant
- Recommendations to Improve Lubrication
- Lubrication Schedules and Controls
- Skilled Engineering Counsel
- Progress Reports of Benefits Obtained

GARGOYLE Lubricants

Socony-Vacuum Oil Co., Inc.

and Affiliates: Magnolia Petroleum Company, General Petroleum Corporation



Corrosion Resistance and Long Life with Alloy Steel Castings

* Atlas alloy and stainless steel castings are higher in their resistance to acids, corrosion and heat, because the analysis is strictly controlled. Having pioneered many of the revolutionary casting methods used today, Atlas metallurgists are able to cope with all alloy steel casting problems. Your inquiries are invited.

Our Illustrated Bulletin 45 contains 8 pages of helpful data . . . two full pages of physical properties . . . write for it today.

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SALARIES AND STATISTICS

NEW jobs in the chemical industries are predictable from economic studies, and forecasts of future employment are quite possible from data now collected and being gathered from chemical engineers. A new technical job is created in the plastics and synthetic resin field for each 200 tons additional manufacturing capacity. In the petroleum field, each increase of 200,000 bbl. in the amount of crude going to the refinery means another position has been opened for some technically trained person. This does not include the jobs opened at the same time for unskilled help.

Salaries of chemical engineers show a wide spread between high and low figures, a characteristic of professional earnings, and salaries also increase with length of experience.

In 1943, 10 percent of the chemical engineers, 4.5 years after graduation were earning more than $364 a month and 90 percent were receiving more than $217, the median salary being $275. In that same year, 25 percent of the engineers with 28.5 years of experience were paid more than $902 a month, 75 percent were earning more than $444, and the median salary for this group was $629 a month.

It was found in recent surveys 7.3 percent of the nation's chemical engineers were located on the Pacific coast, most of them in California. In 1926, the percentage of chemical engineers was only 6.1. The increase, over a 17 year period reflects a growth of chemical engineers in this region from about 500 in 1926 to about 2,000 in 1943.

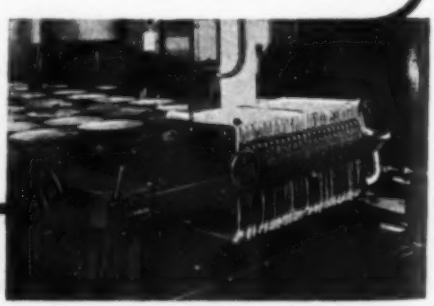
Private firms employ 83 percent of the chemical engineers, the federal govern-

Old Method or New Product? Here's a Guide to Better Filtration

If you're stymied in your process because the material makes filtration, clarification, washing, extraction or thickening slow and uneconomical with your present filter — If you're developing a product the filtration characteristics of which are difficult to determine —

Let this Shriver Filtration Guide and the Shriver Laboratory show you — free — how a Shriver Filter Press, versatile as to application, design, construction and capacity, can help lick your problem — no matter how difficult. Write.

SHRIVER FILTER PRESSES



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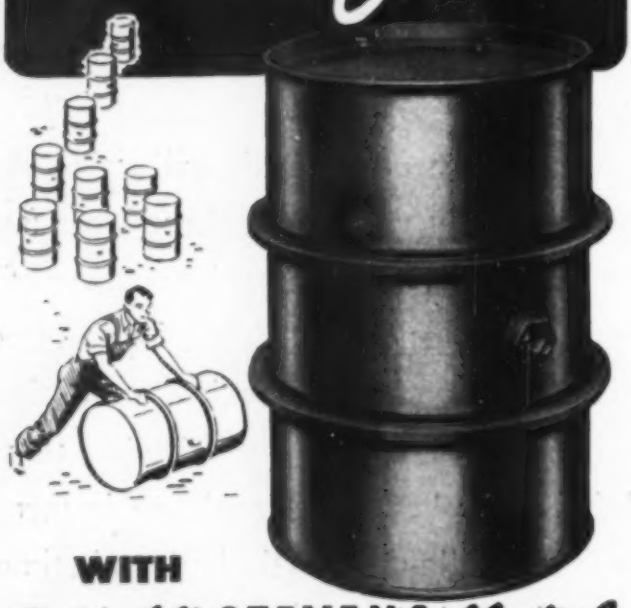

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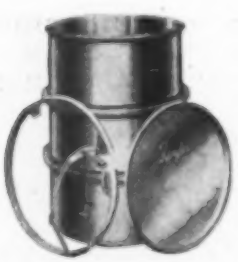

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METAL BARRELS AND DRUMS

ment employs 5.6 percent and the state governments 2.4 percent, and the oil industry employs 15.7 percent. This field is one of the major sources of employment for the profession. There will be expanding opportunities in other industries, such as foods, textiles, and leather, which now do not have many chemical engineers. The versatility of the profession is a valuable asset in such lines of manufacture.

L. W. Bass, Air Reduction Co. and U. S. Industrial Chemicals Inc., before Northern California Section, American Institute of Chemical Engineers, San Francisco, Aug. 26, 1946.

TETRAETHYL LEAD IN COFFEE

Facts and logic, seem of very little interest to detractors of the patent system. At a public hearing Thurman Arnold airily dismissed the tremendously valuable ethyl gasoline patents with the remark: "Now whether these patents were good, I do not know. It struck me at the time, what else could you do with tetraethyl lead but put it in gasoline? You can't put it in coffee."

Such statements by government officials are particularly dangerous in complex scientific matters which the lay public cannot understand. Arnold's statement would have been much less dangerous, though no less unsound, if he had said: "Now whether these telephone patents were good, I do not know. It struck me at the time, what else could you do with a telephone but talk over it. You can't play tennis with it."

R. E. Wilson, Standard Oil Company of Indiana, before Princeton University Bicentennial Conference, Oct. 4, 1946.

MAGNESIUM AS A GALVANIC ANODE

Increasing use of cathodic protection for corrosion mitigation on various commercial and industrial structures, such as pipelines, storage tanks, lead cable sheath, and chemical process equipment, has aroused widespread interest in the development and use of galvanic anodes. To many such applications of cathodic protection the galvanic anode brings a number of advantages which are often reflected in a lower over-all cost of protection. Zinc anodes have been employed long and extensively for the protection of marine structures, and within the past decade, the use of zinc has been extended to applications involving buried pipelines. Comparatively recently, much interest has been exhibited in the development and use of the light metals, magnesium and aluminum, as galvanic anodes. Both of these metals are now available in large quantities, as a result of wartime expansion of production facilities, and both metals have properties to recommend their use as galvanic anodes.

The general conclusions derived are as follows: (1) The potential of the magnesium anode is ample for cathodic protection purposes in most naturally occurring electrolytes. (2) Both anode current efficiency and the uniformity of anode consumption improve with increasing current density. Efficiencies of 50 to 60 percent (500 to 600 amp.-hr. per lb.) are obtained

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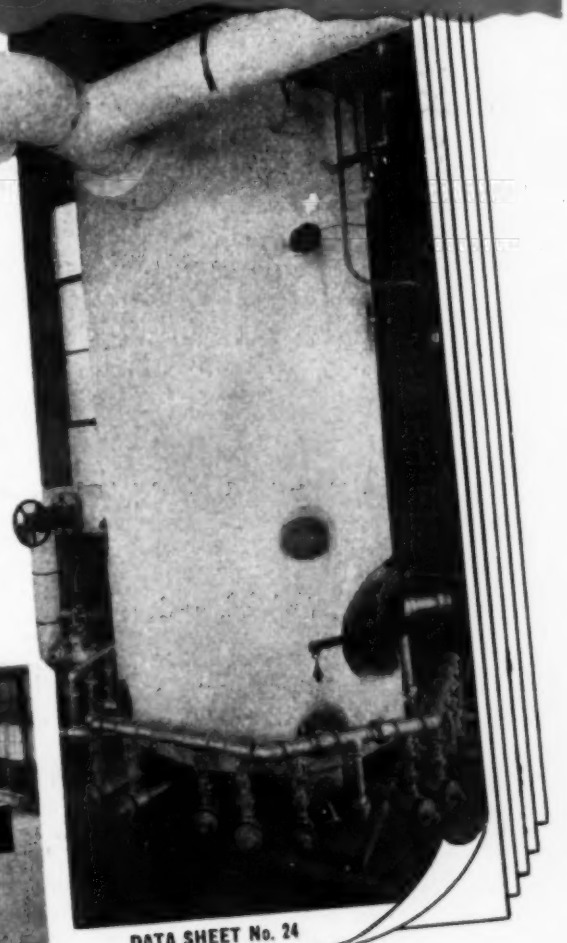

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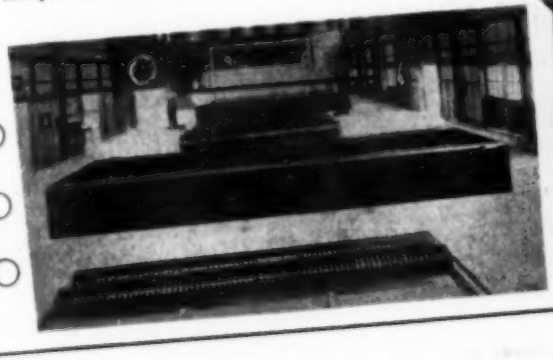

DATA SHEET No. 24

Your processes may have nothing to do with asphalt, but if they involve heat transfer, chances are you can do better with a McKee DOWTHERM Vaporizer. You'll get a High Rate of Heat Transfer under Perfect Control — put an end to direct-application overheating — eliminate the expense and hazards of high pressure systems: only 90 lbs. pressure with Temperatures up to 700 deg. F.! The McKee Dowtherm Vaporizer is a *complete package,* fully assembled ready for installation, and with one responsibility for successful performance. Gas or oil fired; in models from 30,000 to 2,000,000 BTU. Write for FREE Bulletin and other Dowtherm Case Histories. Eclipse Fuel Engineering Co., 721 South Main, Rockford, Illinois.

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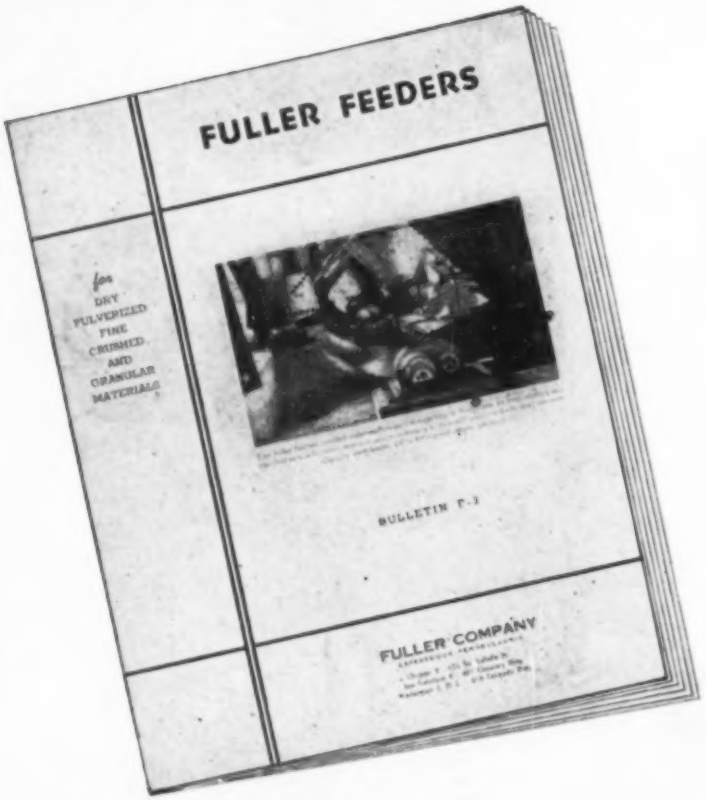

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F-8

with magnesium alloy anodes for current densities in excess of 50 to 100 milliamp. per sq. ft. (3) The high purity Mg-Al and Mg-Al-Zn alloys perform much more efficiently than pure commercial magnesium at current densities up to about 700 milliamp. per sq. ft. Of the various compositions tested, the Mg, 6 percent Al, 3 Zn, 0.2 Mn alloy exhibits the best overall performance characteristics. (4) Saturated aqueous solutions of either $CaSO_4$ or $MgSO_4$ provide the most generally satisfactory electrolytes for magnesium anode operation. An electrolyte pH of 9.5 to 10.5 is optimum. Higher pH values produce polarization and lower pH values reduce current efficiency by stimulating local corrosion.

H. A. Robinson, The Dow Chemical Co., before the Electrochemical Society, Birmingham, Ala., April 1946.

APPREHENSIVE BIKINI REPORTERS

MANY of the reporters at Bikini did not expect to live, and hence assumed the atomic bomb was a dud when they survived the first blast. The surprise felt by some writers at still being alive caused them to lose their objectivity and was one of the factors responsible for the false impression given to the American public that the bomb was "just another Fourth of July firecracker."

There was little doubt that the bomb detonated at Bikini was somewhat less efficient than those detonated at Alamogordo, Hiroshima and Nagasaki. However, despite the alleged inefficiency of the bomb detonated on Able Day, the amount of destruction was sufficient to prove beyond any doubt that the atomic bomb is a revolutionary new weapon and the most dangerous one that man has yet devised.

Walter J. Murphy, editor, *Industrial & Engineering Chemistry*, before American Chemical Society, Chicago, Sept. 11, 1946.

POTENTIAL MARKET FOR VINYLS

NATIONAL dollar-volume consumption of plastics of all types has grown from $20 million to $95 million in the years 1936 through 1940 and, further stimulated by war needs, will reach $750 million this year—37½ times what it was only 10 years ago.

In April of this year, the production of vinyl resins had reached an annual rate of 119,600,000 lb.—almost 10 times the 12,000,000 lb. produced in 1940. Despite a ten-fold increase since 1940 in production and use of vinyl resins, there still are potential markets in coated fabrics, coated paper, film and sheeting capable of absorbing more than 10 times the volume of such resins currently being produced for those uses. This estimate was based on a "reasonable and conservative" replacement of present materials with vinyl resins, plus creation of new and superior articles.

Estimates of 1947 weekly earnings and cost of living indicate that purchasing power will be substantially greater next year than it was in 1941, despite the increase in cost of living. The prospect is for weekly earnings 62 percent above

Why it pays to bring tube problems to B & W

BABCOCK & WILCOX is a logical place for refineries and chemical plants to turn for sound, practical answers to all tubing problems—for a number of good reasons.

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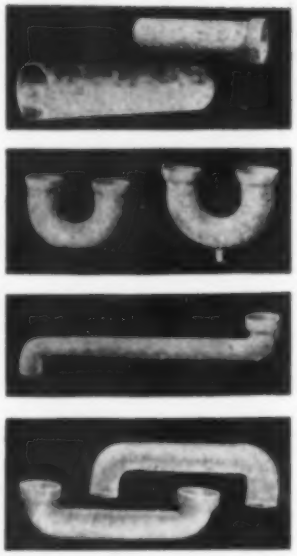

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the 1941 level, with cost of living 42 percent higher than in that year.

On the other hand, the time is not far distant when, in contrast to the present seller's market, production will be equal to demand and in many cases greater than demand, which is the condition we have mostly been accustomed to in America.

James J. Newman, B. F. Goodrich Co., before a Koroseal Forum, New York, Sept. 10, 1946.

PRODUCTS FROM CHINESE TALLOW TREE

THE Chinese tallow (Stillingia) tree grows along with tung trees in China and was reported in the United States as early as 1848. It grows rapidly in Houston, Tex., and does well, even under adverse conditions, and is used extensively as an ornamental. It usually bears seed the fourth year and the first crop is about 70 lb. The crop of seed increases rapidly with increasing age.

The seed contains 20 percent oil, 24 percent tallow, 11 percent extracted meat, 8 percent fiber, and 37 percent shell. Further investigations should be carried on to determine whether the Chinese tallow tree could be utilized economically for the production of tallow, drying oil, protein, and for other products.

W. M. Potts, Texas A & M College, and D. S. Bolley, National Lead Co., before The American Oil Chemists' Society, New Orleans, May 15, 1946.

FRITTERING AWAY OUR LEADERSHIP

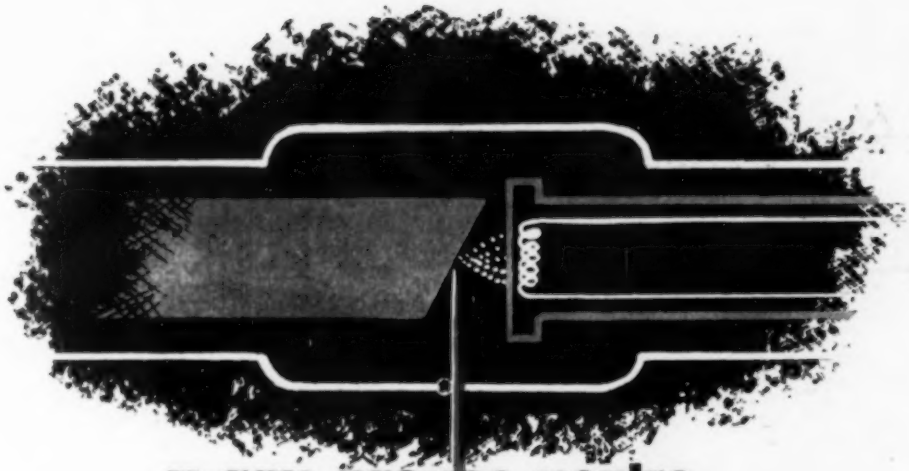
ENLARGEMENT of industrial research institutions to the detriment of university faculties during the 1930's, a Selective Service system which recruited young scientific talent from the schools and colleges to increase the infantry, and a lack of comprehension of the dependence of national defense upon science constitute a series of blunders which, unless soon halted, will lead to complete national suicide.

Such has been and is the planning of our present leaders, but it would not have been the planning of those who really understood this modern world of science. If there is to be a next war, present policies may already have lost it, at least technologically speaking.

Leadership in the world of science and technology, if once lost, will be almost impossible to regain. Britain and the USSR are giving powerful state support to research in pure science. Some means must be found by industry and government to support fundamental science in the universities on a broad basis if only in self defense.

The nation will suffer in the near future as a result of the undermining of scientific training during the war. By 1955 the country will be short of more than 8,000 Ph.D.'s in the physical sciences alone, according to estimates of the National Research Council.

Even though we possess the secrets of the atomic bomb, we have no cause for smugness. It is just as possible for this nation to lose its present position as it



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was for Germany to do so in 1914. What is more, failure to grasp the import of this basic truth during the decade of the 1930's actually started the decline. Then came war and the policies largely dictated by the military have greatly accelerated the process.

This country has not lost its high place in science by one big gamble as did Germany in the first war, but has been frittering it away in a series of mistakes and bad decisions.

The policies of Selective Service completely eliminated a generation of young scientists. Graduate training, so essential in the preparation of independent investigators, practically ceased for lack of students. Our allies, who were intelligent enough not to make such a blunder, are not now holding back their scientists so that we can catch up in this race for new knowledge.

The armed forces must readjust their concepts of national strength to that of a modern world. Steps must be taken immediately for the complete release from the armed forces of all unneeded scientists and technologists so that they may, by their talents, best serve the nation in the difficult postwar adjustments. All talented 18-year olds are still inducted into the armed forces instead of going ahead with their fundamental training.

The nation has reached a crossroad in science. To proceed as we have been will lead down a road marked closed because of incompetence. The turn must be made now, and the bad decisions rectified. From now on, the strength of a great nation such as ours will depend on the strength of science.

Lloyd Reyerson, University of Minnesota, before the American Chemical Society.

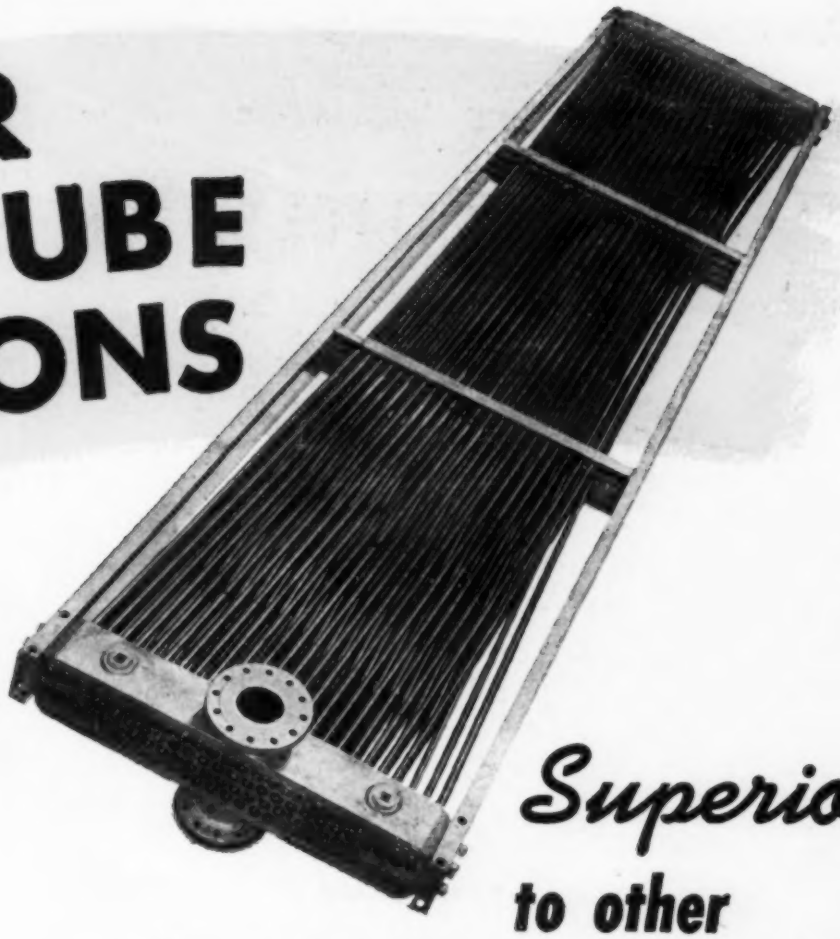
ENGINEERING PROFITS OUT OF GARBAGE

DEHYDRATION of garbage, followed by oil-milling, is sanitary and requires only a moderate investment. Satisfactory commercial yields of grease and oil-cake meal have been obtained by oil-milling dried garbage from ordinary municipal collections in Los Angeles. The meal obtained was eminently suitable for fertilizer. Considerable hardware, textiles and other materials had to be refined out of the rubbish received.

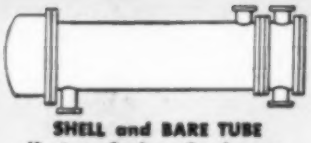
Municipal garbage is remarkably uniform in composition throughout the United States. Its moisture content ranges between 68 and 82 percent, while the percentage of dry solids of animal and vegetable origin runs between 18.5 and 27.5 percent.

In these dry solids lie the potential values of garbage. In the terms generally used in reporting the analyses of foodstuffs, these dry solids, calculated on various Los Angeles samples, contain from 14.2 to 23.0 percent of protein, 33.8 to 41.0 percent of carbohydrate, 17.1 to 22.0 percent of fat, 8.45 to 12 percent of fiber and 11.6 to 17.6 percent of ash. Translated into the terms of fertilizer analyses a survey of the United States as a whole indicates that the dry solids contain from 1.39 to 3.42 percent of nitrogen, 0.02

G-R BENTUBE SECTIONS



ONLY G-R BUILDS THIS WIDE VARIETY OF HEAT TRANSFER APPARATUS



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to 3.81 percent of phosphoric anhydride and 0.43 to 1.10 percent of potash.

Experiments were also made with garbage freshly dehydrated daily and before spoilage could occur in a number of institutions where large numbers of people are fed. Results were especially successful. The grease yield was suitable for soap-making or for fat splitting operations, and the oil-cake meal was a useful component in mixed feeds for poultry, swine, beef cattle, and even dairy cattle.

W. A. Bush, California Flaxseed Products Co., before Water, Sewage, and Sanitation Division, American Chemical Society, Chicago, Sept. 9, 1946.

CONCURRENT FLOW IN TCC OPERATION

THE PAULSBORO, N. J., commercial TCC installation of the Socony-Vacuum Oil Co. has operated in a completely satisfactory manner since March 1946 with concurrent flow of catalyst and oil through the reactor charging both vaporized and partially vaporized stocks. During this period the vapor-catalyst disengager (which is necessary for concurrent flow) functioned efficiently, steam purging of the spent catalyst was accomplished more easily than on countercurrent flow, and distribution of the liquid and vapor charge through the reactor bed was uniform.

Concurrent flow results in better heat utilization in the reactor than countercurrent flow, i.e., a higher average reactor temperature for given oil and catalyst inlet temperatures. The difference in favor of concurrent operation is about 50 deg. F. for catalyst and oil inlet temperatures of 1,000 deg. F. and 900 deg. F., respectively, and for catalyst oil ratios in the neighborhood of 2:1. The higher average reactor temperature for concurrent flow results in higher octane number gasolines.

In view of the favorable results obtained from the Paulsboro unit, the decision has already been made to convert a considerable number of commercial reactors using this Houdry-licensed process to concurrent flow. The cost of this conversion is exceedingly small, being only about 1 percent of the initial investment for the plant.

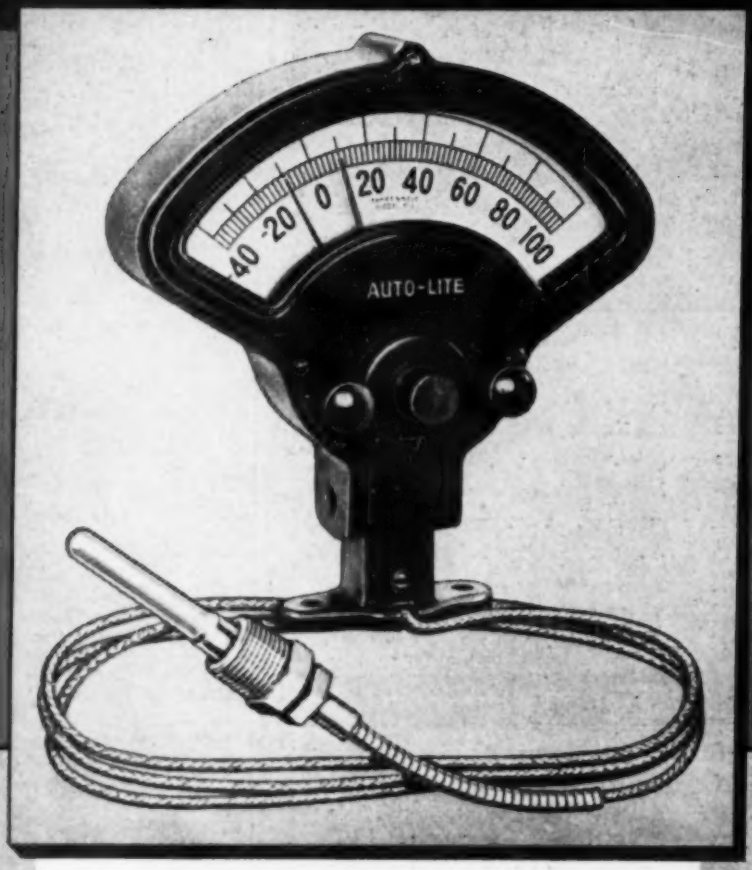
H. D. Noll, Houdry Process Corp., before the National Petroleum Association, Atlantic City, Sept. 19, 1946.

SEPARATION OF OXYGEN FROM NITROGEN

THERE is one element—oxygen—which has not always been used efficiently as a chemical raw material.

For most purposes oxygen is more efficiently used in the form of air. For some applications such as welding and cutting of metals it must be of a purity of about 99.5 percent. Although the tonnage is considerable it is minor in comparison in the future use of oxygen in higher concentrations than air, namely, from 21 percent up to strengths of 95 to 97 percent. If oxygen can be isolated efficiently, and by that is meant at a low cost, it can be used for purposes hitherto unattainable. There is good evidence from foreign and domestic researches that oxygen of 95 to 97 percent can be produced for about $4 per ton, all costs included, by air lique-

RING THE BELL *on Temperature*



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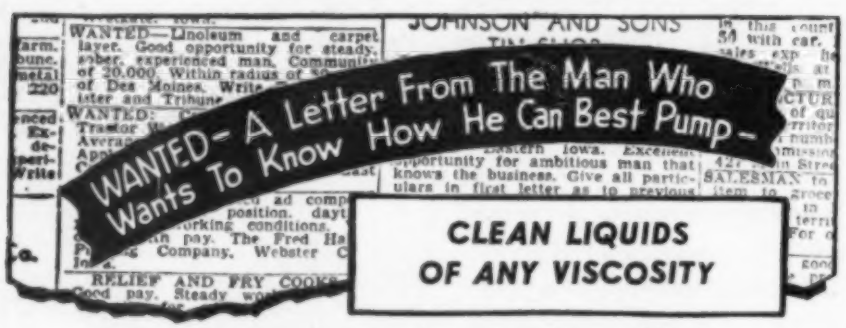
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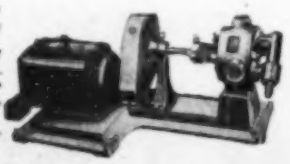

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faction and rectification when made in large quantities. Oxygen of this strength, or used to enrich air, promises great advances in the production of pig iron and steel; in the roasting of copper, zinc, lead and nickel sulphides and pyrites; in the production of strong sulphur dioxide for recovery as such or for conversion to sulphuric acid; for the oxidation of ammonia or perhaps the direct combination of nitrogen and oxygen to nitric acid; in the production of "synthesis gas" from natural gas, refinery gases or coals with subsequent conversion of the synthesis gas to liquid fuels and oxygenated products; for the continuous gasification of coals to make improved producer gas and city gas of sufficiently high thermal content to satisfy statutory requirements and for many purposes where nitrogen is a detriment and high temperatures are advantageous. The underground gasification of coal is a possibility but we should learn to creep before we attempt to run.

Separation of oxygen from nitrogen by the most efficient means is a problem requiring the best efforts of physicists, chemists, mechanical engineers and chemical engineers because it is a problem of great importance.

C. R. Downs, before Princeton University Bicentennial Conference, Oct. 2, 1946.

POTATO STARCH WASTE

Potato production in Maine, 1935 to 1944 inclusive, was from about 36,000,000 bu. in 1939 to about 73,000,000 bu. in 1943. The corresponding figures for the total United States production for this period varied from about 323,000,000 to about 465,000,000 bu.

With about 7 percent of the potato wasted in potato starch production; with 60 lb. of potatoes per bu., the waste in Maine (almost entirely in Aroostook County) would be from about 151,000,000 lb. for the 1939 crop to about 337,000,000 lb. for the 1943 crop on a bone-dry weight basis. This quantity of waste material with a high carbohydrate content and an appreciable protein content could well be used in mixed feed for animals when incorporated with a high fat and protein oil meal. Much of the pulp accumulates on stream and river beds and in lakes, and in low water stages, some of the carbohydrate material undergoes fermentation.

C. A. Brautlecht, University of Maine, before Division of Water, Sewage and Sanitation Chemistry, American Chemical Society, Chicago, Sept. 9, 1946.

EFFICIENT UTILIZATION OF MATERIALS

With coal and oil alone, plus water and air, and a few other chemical raw materials, we conceivably might build an entirely new industrial structure based on products of such enhanced usefulness as to render obsolete many earlier products once regarded as indispensable. The obsolescence that has already occurred as a result of the chemist's entrance into these two fields is truly tremendous. Yet it may easily be dwarfed in a few years by newer developments under way or closely pend-

Dopp

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3. *Have "Scraping Agitator" that cleans as it mixes!*

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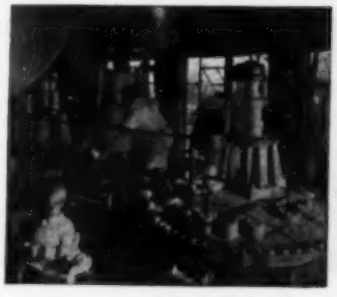
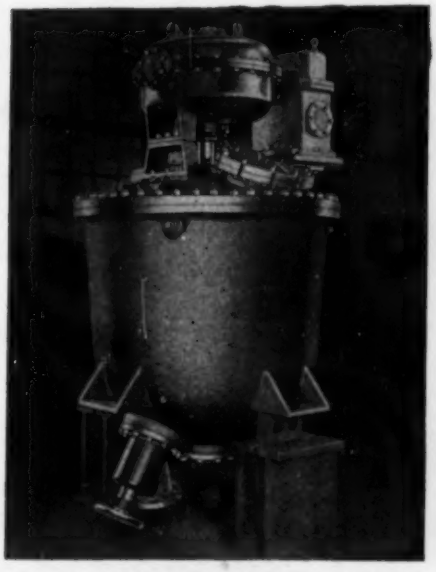
Wherever mixing, heating, or cooling is an operation in batch processing, DOPP Kettles are widely used. Among the industries served are grease, pharmaceuticals, resins, plastics, soaps, food products, adhesives, and many others.

Experimental Kettle



Vitamin Plant



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DOPP Kettles can be furnished for applications requiring alternate heating and cooling. This rapid operation shortens production time; saves material handling, and eliminates extra pieces of equipment. In many industries, this is a profitable operating advantage, because cold water can be run through the jacket quickly after the steam is turned off and the pressure released. This method can also be used to prevent over-heating the product or to check a reaction.

Performance records show that in some cases, operating time has been cut to one-fourth of the former time. These results are attained through the design of the rigid, one-piece, seamless kettle body and a positive scraping agitator that both thoroughly mixes and keeps the heating surface free from accumulated material, thereby providing the maximum heat transfer.

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DOPP Kettles are available in Seamless Jacketed or Single Shell construction with standard covers for pressure or vacuum operation. Holding capacities can be increased by the addition of jacketed or single shell belts. Outlets of various types can be provided. The sizes of these kettles range from 15 to 1700 gallons capacity.

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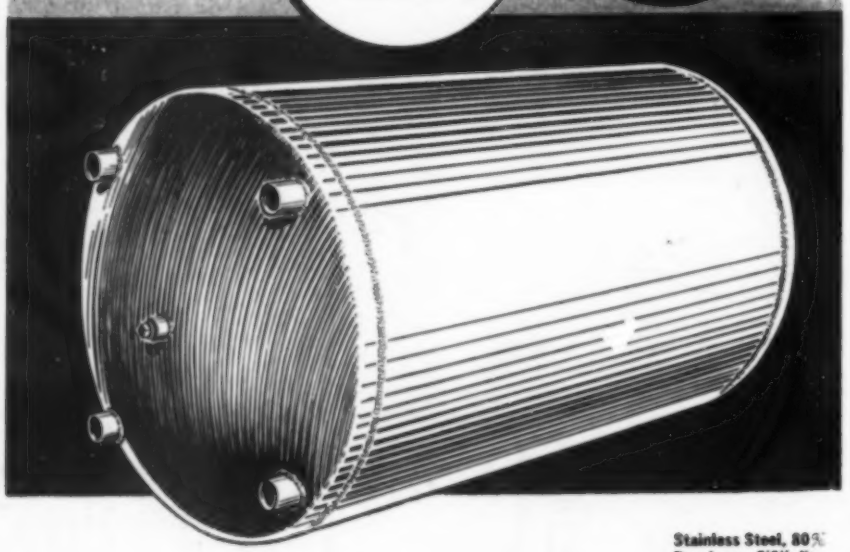

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ing. Today, who is prepared to say, in view of the established position of synthetic rubber, what is to be the future of natural rubber? Or of silk, in view of the invention of nylon?

The world will always find uses for silk and rubber, but they are no longer indispensable. We can do without them if we choose. The extent of their future use is speculative. By contrast, the future of synthetic textile fibers, synthetic rubber, and of many other synthetic organic materials is not open to question. The future of the synthetics, and the relative importance of each in the general scheme of things, is limited only by the ingenuity of the scientists.

Theoretically, there is no limit to that ingenuity. That being true, the master key to the problem of utilizing all materials most efficiently becomes manpower, specifically technical manpower. The effectiveness of any given group of men that applies itself to this problem, here or anywhere in the world, is bound to be in direct ratio to the number and quality of technically trained men that the group contains, and the degree of influence they exert in guiding the practices of the entire group.

The war just closed proved this conclusion beyond all debate. It demonstrated that no modern nation is stronger than its industry, and that no industry is stronger than its technical manpower. Peace presents problems in material utilization even greater than those of the war. Moreover, they are growing problems.

Let us not deceive ourselves. This problem of efficiently utilizing the materials still left at our disposal is one of major importance. It has been accentuated by the war. During the war we expanded our producing facilities beyond the most sanguine estimates. At the same time, we expended raw materials and finished goods on so huge a scale that some sources of supply were seriously diminished. We can grow more wheat, but we cannot grow more copper and iron. Add to this unpleasant fact the further one that the task of rebuilding what was destroyed by war, and of replacing what was worn out, will demand an additional expenditure of materials fully as great as the volume destroyed and used up, and one begins to grasp the staggering size of the issue.

C. M. A. Stine, E. I. du Pont de Nemours & Co., before Princeton University Bicentennial Conference, Oct. 2, 1946.

MORE FORECASTS FOR PETROLEUM

Use of petroleum in the next quarter century will reach a new peak despite the competition of atomic power.

Petroleum is a limitless source of chemical raw materials, and there will be a fivefold expansion of the already huge organic chemical industry incident to the ever greater utilization of synthetic textiles, plastics coatings and a host of other products meeting the everyday needs of man. The consumption of oil as fuel, however, will continue to be infinitely more important from the standpoint of volume.

In the next five years, barring a catas

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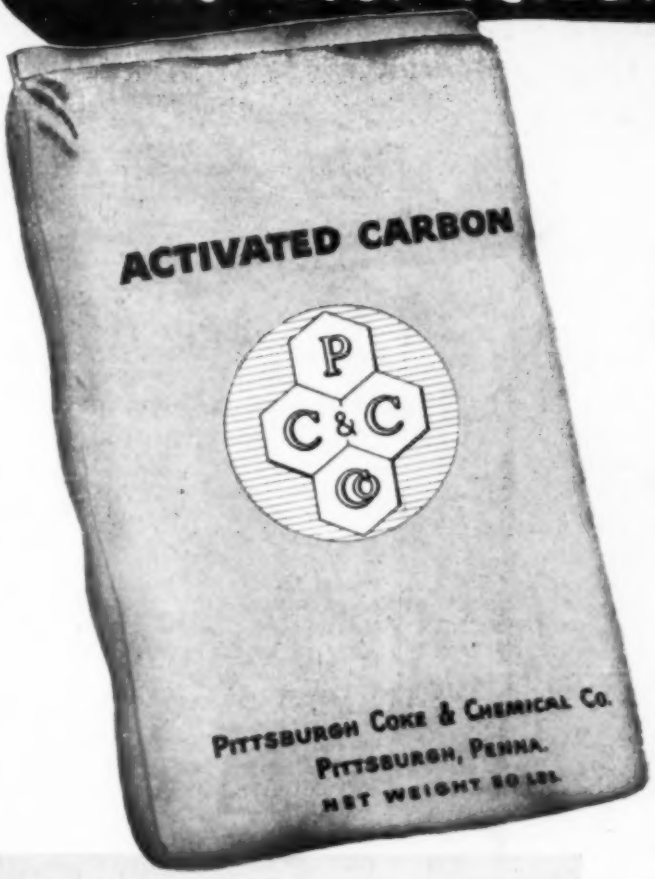

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Hydrocarbons Acenaphthene, Anthracene, Chrysene, Dimethylnaphthalenes, Fluoranthene, Fluorene, Methylnaphthalenes, 2-Methylnaphthalene, Naphthalene, Phenanthrene, Pyrene

Bases 2-Amino-3-Methylpyridine, 2-Amino-4-Methylpyridine, 2-Amino-5-Methylpyridine, 2-Amino-6-Methylpyridine, 2-Aminopyridine, 2-Amylpyridine, 4-Amylpyridine, N-n-Butylcarbazole, Dipyridylethyl Sulfide, 2-Ethanolpyridine, 4-Ethanolpyridine, N-Ethylcarbazole, 2-Hexylpyridine, Isoquinoline, Lepidine, 2,6-Lutidine, 3-Methylisoquinoline, 2-(5-Nonyl)Pyridine, 4-(5-Nonyl)Pyridine, Alpha Picoline, Beta Picoline, Gamma Picoline, 2-Mercaptoethylpyridine, 2-Propanolpyridine, 4-Propanolpyridine, Pyridine, Quinaldine, Quinoline, 2-Vinylpyridine

● Listed above are a few of the many refined coal tar chemicals that have been made available to industry through REILLY research and development. These products, which are supplied in 90% or higher purity, have a wide range of applications, including the manufacture of pharmaceuticals, antiseptics, insecticides, fungicides, rubber chemicals, photographic compounds, dyestuffs, plastics, printing inks, the synthesis of organic chemicals, and as additives to gasoline and lubricants.

Now in its fifth decade of service, REILLY has been a dependable source of supply for coal tar products, including all of the regular coal tar chemicals of importance to industry, creosote oils, cresylic acids, roofing, waterproofing and paving pitch, protective coatings for metal, brick, concrete and wood surfaces, wood preservatives, carburizing compounds, pickling inhibitors, wood block flooring, and creosoted lumber, timbers, poles, piling and railway ties.

This 56-page booklet and supplement describing the complete Reilly line of coal tar chemicals, acids, bases, oils and intermediates, will be sent on request.

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Reilly Coal Tar Chemicals For Industry

trophic depression, all signs point to a vast increase in the use of petroleum and an upgrading in quality in virtually all its major products. Estimates are that consumption of gasoline will rise 25 percent, kerosene 7 percent, lubricants 20 percent, asphalt 35 percent, liquefied petroleum gas 25 percent and distillate fuels for home heating 75 percent. The most phenomenal increase will be in the field of diesel fuels, which are expected to show a 100 percent expansion largely as a result of an anticipated rise in diesel trucks and diesel locomotives.

Even with the tremendous expansion which lies ahead, there is no danger of an oil famine.

Bruce K. Brown, Standard Oil Co. of Indiana, before the Petroleum Division, American Chemical Society, Chicago, Sept. 10, 1946.

SOME BACKGROUNDS OF OUR INDUSTRIAL DEVELOPMENT

THE MANUFACTURE of petroleum products is today part of the chemical industry. The only branch of the production end of our petroleum industry remaining outside of the chemical field is the drilling of oil wells and the transportation and storage of oil. From the processing of crude oil to the finished products, it is chemical processing.

As to rubber, we are witnessing a great duel between natural and synthetic rubber. In ten years the synthetic products will be preferred for most uses and will be used in America in greater volume than the natural product.

The great textile industry is faced with similar revolutionary changes. The chemist has for some years produced synthetic fibers in competition with the old staples—cotton, wool, silk—and while he is continuing to develop synthetic fibers, he has quite recently turned his attention to the improvement of the natural products. Our old and honorable textile industry will be forced into an evolution similar to that undergone by the petroleum industry.

While this illustrates the growing importance of chemistry, it does not mean that it is absorbing the textile, petroleum, rubber, and paint industries. There is, however, a very distinct evolution of these industries, which compels them to enter the chemical field and employ chemists, physicists, and technologists.

Recent developments and achievements in technology are today well known and were the direct result of a combination of factors which include: (1) A better recognition of the importance of technology to any nation, and in particular, of the importance of the relatively new field of chemistry. (2) A recognition that science and research are the best growth catalysts and therefore it is imperative that our colleges equip men with an understanding of the complex facts of science and with a vision of things to come.

Our chemical industry has done very well, but we were geared to do just that, it was expected of us, research has been our life's blood for years. During the last ten years we have laid the foundation for the great plastics industry, which will grow by leaps and bounds during the coming years. Finally, the chemical industry

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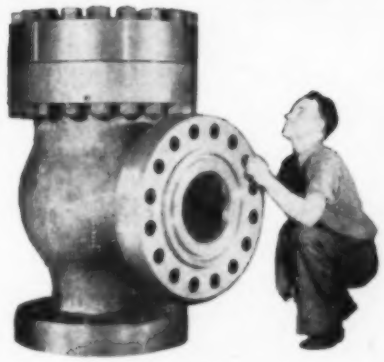
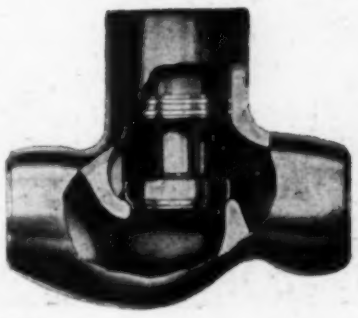
FOR large, medium or small lines . . . for horizontal, vertical or angle installations . . . for 150 lb to 7500 lb service . . . stainless steel or Stellite trim . . . whether you need flanged, screwed or welding ends—there is an Edward steel check valve to meet your requirements. Many sizes and types are in stock for immediate shipment.

BIG CHECKS



Vibration, clatter and damaging shock to piping are eliminated with Edward piston-type check valves. Integral guide ribs, cored out for free flow, guide the hourglass disk-piston throughout travel to prevent hanging up. New flow contours reduce pressure loss, increase operating efficiency. Built in sizes through 14 in.



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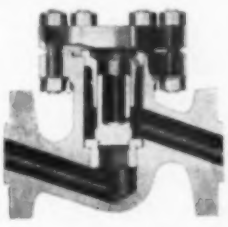
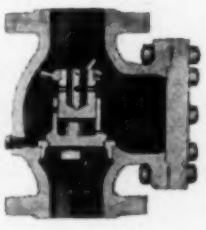
MEDIUM



Exclusive Edward disk guide lip aids tight seating and cuts wear on seat and disk through momentary throttling action.

Edward check valves may be disassembled without removing from the line. Covers are forged steel.



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Design of small Edward checks permits use in either horizontal or vertical lines. Built in sizes down to ¼ in.

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of America, together with hundreds of physicists from many lands, has initiated the greatest project of all time, based on nuclear physics, carried forward with the people's money and the brains of a few outstanding scientists. Here again we worked out a system of new manufacturing methods, really novel, ingenious, and intricate, with potentialities which have stirred the world.

Technically speaking, the future is bright, very bright, but there is one dark cloud on the horizon.

Germany lost the war, not because of any deficiency in scientific or technological progress, but on account of deficiency in moral or ethical progress. The moral standard of Germany's government was below that of the people of Germany. While we cannot draw an absolute parallel in our case, there are increasing indications of overloading of government duties and functions. Our government is bungling and is allowing partisan politics to play too great a part in decisions on policies.

This is the greatest problem of our day, not only for industry and labor, but probably more so in the conduct of our government, which needs more honest and straight judgment. The spirit of partisanship in executive government functions must go, we need more plain common honesty.

Gaston Du Bois, Monsanto Chemical Co., before Princeton University Bicentennial Conference, Oct. 2, 1946.

MECHANISM OF CATALYTIC CRACKING

THE MECHANISM by which cracking catalysts function is undoubtedly the least understood of all important catalytic reactions. Commercial cracking catalysts are of two general types, although these are very similar in their action. The catalyst first used successfully is a special type of natural clay which has been activated by leaching in acids. Later, improved catalysts were developed by synthetic methods. These consist of silica in combination with other metal oxides such as alumina, zirconia, and magnesia. It has been difficult for the chemist to explain the action of such catalysts on the basis of intermediate complexes, because silica and the other oxides which are necessary to the catalyst are not known to react directly with hydrocarbons.

Research work has shown that one important component of cracking catalyst has been overlooked, namely, water. All active cracking catalysts contain a small amount of water, and if this water is removed the catalyst ceases to function. By replacing the ordinary water in cracking catalysts with heavy water it has been shown that the atoms of heavy hydrogen in the heavy water exchange with the atoms of light hydrogen in the petroleum molecules.

This proves that water combined with the catalyst is the link between the catalyst and hydrocarbon during the cracking process, making possible an explanation based on the formation of an intermediate complex. It is now believed that the chemical nature of cracking catalyst surfaces is very similar to that of a fairly strong acid, water being the source hydrogen ions. These ions may react with a petroleum

HERE'S A *Natural* FOR SHREDDING ALL TYPES OF *Synthetic* RUBBER

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When problems arise involving the handling of acids, alkalies, gases and chemicals, the industry turns to Knight engineers and craftsmen for the most practical type of acid-proof equipment.

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CHEMICAL EQUIPMENT

molecule to form an intermediate complex. or hydrogen can be taken from a petroleum molecule in the form of a hydrogen ion, creating an intermediate complex from the original molecule. These intermediate complexes are less stable than the molecules from which they are formed, and can decompose to smaller molecules having a different structure from that found for the molecules produced directly from the large molecule.

R. C. Hansford, Socony-Vacuum Laboratories, before Petroleum Division, American Chemical Society, Chicago, Sept. 10, 1946.

HOW CAN ATOMIC ENERGY BE CONTROLLED?

CAN atomic energy be so developed and so controlled that it will be used only for the advancement of human welfare and not be used for war and destruction? No answer to this question will be genuinely workable unless it is agreeable to every one of the great powers and all, or substantially all, the nations of the world. This is quite in order.

It was scientists and technical men who gave the world the large-scale release of atomic energy. This is the supreme achievement to date of the scientific spirit and the scientific method. The only hope to control atomic energy and prevent its use for destruction lies in applying the scientific spirit and the scientific method to this problem.

It's not often that there is an opportunity to analyze what is called a political problem in a scientific spirit. But something of the sort did happen last winter. The product was an idea embodied in a document published by our State Department called "A Report on the International Control of Atomic Energy."

This report represented the work and the unanimous agreement of a Board of Consultants of five men, men of widely differing backgrounds and experience. All five had this in common—they had all had responsibility for technical enterprises, and therefore had grown accustomed to the methods of tackling problems that are characteristic not of politics but of technology.

The five locked themselves up for two months, had the whole array of facts, and came up with a plan believed workable. That plan has been widely discussed and is fairly well known. It urged that the people of the world agree to entrust to a world agency, the Atomic Development Authority, the control and management of all activities concerning atomic energy that are dangerous—that is, dangerous to the security of the world—activities that are steps on the road toward the making of atomic bombs. These dangerous steps begin with the raw material: uranium and thorium. Under our proposed plan, factories to produce fissionable materials would all be owned and operated, not by rival nations, but by this world corporation functioning under world law and responsible to all the people.

But it is how our Board of Consultants went about trying to find a plan that is in some ways as important as the answer obtained. It didn't follow the typical political method of starting with the answer

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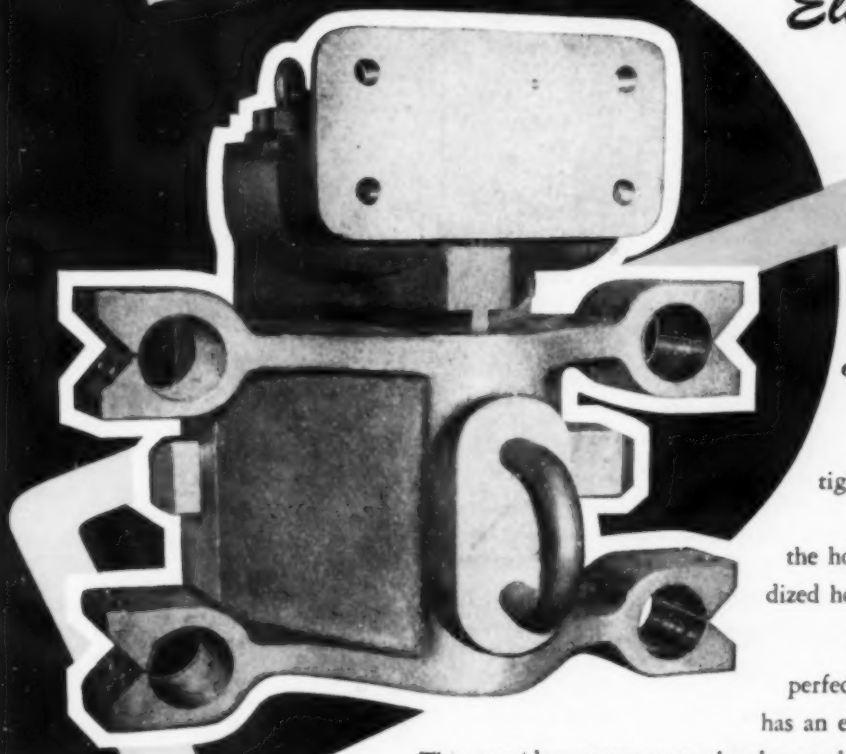

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all neatly laid out, and then look around for facts and arguments to support our pet notion. It didn't start, for example, by asserting that the answer was world government and then pick out facts that would fit that answer. Nor did it say, "National sovereignty must in no wise be infringed," and then try to squeeze out a plan that would fit that dogma. No, it started somewhat as a chemist might, tackling a technical problem: with the facts as he found them.

What facts? Well, fact No. 1 is this: the same materials and operations required to put atomic energy to peaceful purposes are adaptable, virtually without change, to the making of the stuff that goes into atomic bombs. This is true through almost the whole course of producing atomic energy.

In the light of the facts it was just political hoorah to talk about nations concentrating on peaceful purposes as if that called for entirely different processes and materials from those used for destruction. These being the facts, what does an international covenant never to use atomic bombs amount to? How much security—how much peace of mind would anyone get out of that? Mighty little.

Suppose the world agreed to join together to crack down on anyone who violated the international agreement; who despite the agreement went ahead and made and used atomic bombs. We could find precious little security in a plan to punish a nation after it had dropped hundreds of bombs and killed millions of human beings.

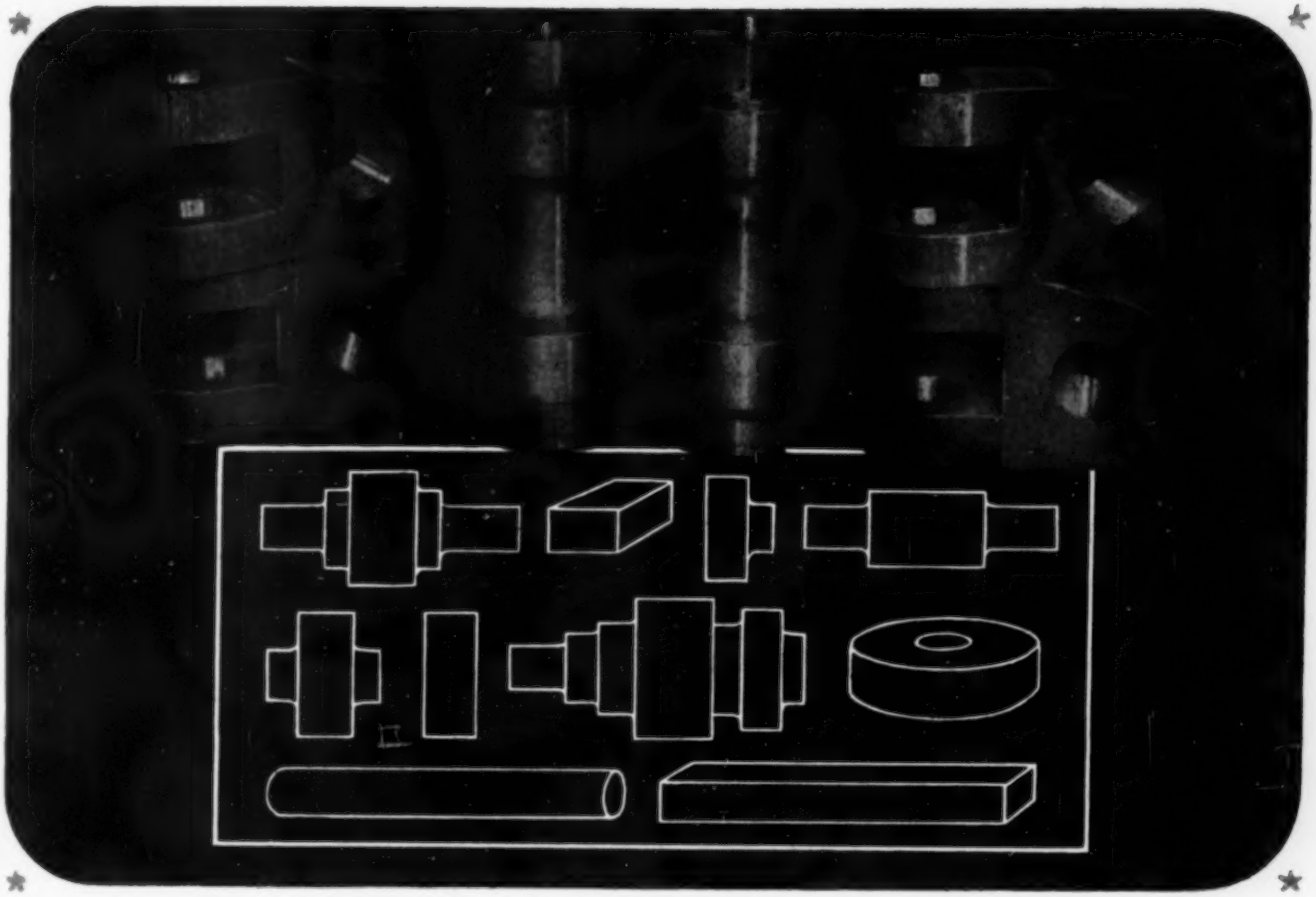
Why couldn't we have an international inspection agency, to snoop into every factory and plant to see whether nations are fulfilling their agreement not to put fissionable material into bombs? A plan of inspection as a sole safeguard is quite unworkable. An inspector simply wouldn't know enough to detect a skillful evasion.

The proposed Atomic Development Authority would not be a mere international detective force, but, as its proposed name implies, a development agency engaged in operations and extensive research. Some people have objected to our proposal because it doesn't guarantee an end to war. That's a valid criticism, for what we set out to do was to find a way to prevent the surprise use of atomic weapons. Everyone would be profoundly happy if someone would come up with a workable scheme that would eliminate all war with one stroke. That's the goal; it must be, of course; but to get to that goal we've got a long way to go and much to learn. Perhaps the best way to get there is to start with the most urgent problem, and that would seem to be atomic weapons.

David E. Lilienthal, Tennessee Valley Authority, before the American Chemical Society, Chicago, Sept. 11, 1946.

ALCOHOL FROM ETHYLENE

Prior to 1930, ethyl alcohol, the oldest organic chemical, and in tonnage one of the most important, was produced for commercial purposes almost entirely by fermentation of the starches and sugars in grains and blackstrap molasses. Today synthetic plants producing it from ethylene are an important source of industrial alco-



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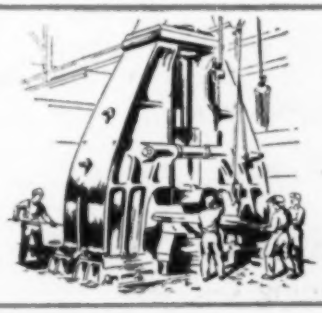

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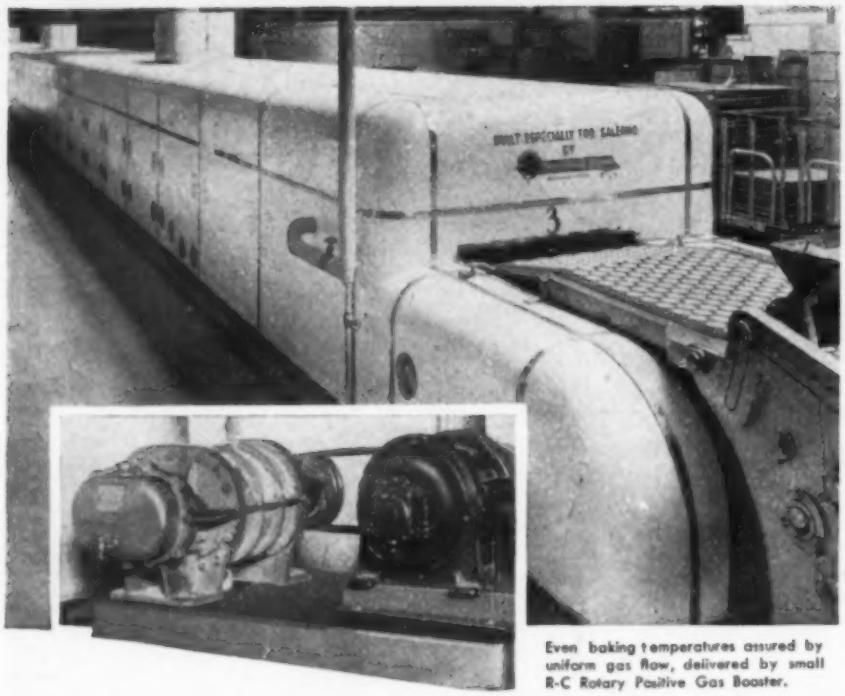

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hol, primarily because of the favorable economics of the process. The production involves specialized cracking operations to make ethylene which is absorbed in strong sulphuric acid under the proper conditions of pressures and temperatures to obtain mixed sulphates. The sulphates are hydrolized and the alcohol with byproduct ethyl ether are recovered by steam stripping from the dilute acid which is subsequently concentrated for re-use. The crude alcohol is refined by distillation and extraction operations to produce industrial alcohol and ether of exceptionally high quality.

C. M. Beamer, Standard Oil Co. of N. J., before American Institute of Chemical Engineers, San Francisco, Aug. 26, 1946.

PRODUCTION OF GUANIDINE NITRATE

EARLY in the war the American Cyanamid Co. was requested by the British to produce large quantities of nitroguanidine to be used in flashless propellants. The production of this material required large quantities of guanidine nitrate which had not been produced on a really large scale. A rapid survey of the available methods, coupled with previous experience which ruled out many of them, showed that none was satisfactory for the purpose, because of yields, purity of product, equipment difficulties, peculiarities of the reactions involved, etc.

Usual starting materials for guanidine nitrate production are cyanamide or its dimer, dicyandiamide, and ammonia nitrate. The reaction of these materials to produce guanidine nitrate is highly exothermic. It can be readily carried out by fusion on a small scale to give excellent yields, but it appeared to be hazardous on the contemplated scale. Experiments using various diluents to control the exothermic nature of the reaction resulted in the selection of liquid ammonia as the most suitable. It had the disadvantage of producing higher pressures, but these were well within the range of accepted commercial usage. The advantages of the process over those involving fusion or the use of water as a diluent were controllability of the reaction, higher yields, and purity of product. The product could be used for nitroguanidine production without purification.

R. C. Swain, K. C. Martin and J. H. Paden, American Cyanamid Co., before Division of Industrial and Engineering Chemistry, American Chemical Society, Chicago, Sept. 10, 1946.

AMINO ACIDS

INDIVIDUAL amino acids may be prepared from proteins or by synthesis. Each type of preparation has its particular advantages. Amino acid molecules can exist in levo and dextro forms. Synthetic products contain equal mixtures of the two forms. Amino acids in nature are almost exclusively left-handed. For many purposes only this form is of value. In these cases the isolated substance often has an economic advantage over the synthetic one.

Besides their uses in nutritional mixtures, amino acids do have, and promise further, value as individual substances. Bacteria require levo amino acids for their growth. It is an interesting fact that the

so-called "unnatural" dextro amino acids are found as a basic structure in the important antibiotics, penicillin and gramicidin, as well as others. It has been found that dextro amino acids and simple derivatives will alone inhibit bacterial growth.

The amino acids are believed to be precursors not only of proteins and antibiotics, but also of vitamins and alkaloids. Chemically and biologically their fundamental relationships insure an accelerating interest in their applications.

S. W. Fox, Iowa State College, before American Pharmaceutical Manufacturers' Association, Lake Louise, Canada, June 10, 1946.

FOREIGN LITERATURE ABSTRACTS

PHOSPHATIZATION OF STEEL PARTS

Work done on the effect of the composition of phosphorus-manganese preparations on the phosphatization of steel parts showed that such preparations should contain a mixture of monomanganese phosphate and free phosphoric acid in a proportion which is very close to the composition of a saturated solution of monomanganese phosphate at a process temperature of 100 deg. in which the ratio of MnO/P_2O_5 is approximately 0.3. This results in a minimum loss of the preparation while the phosphate bath is being made ready. The composition of the saturated solution of monomanganese phosphate at 100 deg. approaches the optimum conditions of phosphatization as established in practice (conditional ratio of the "total titration" acidity to the free acidity is in the range of 6.5-8.0). The conventional method of control of phosphate baths by titration of the solution with alkali, using phenolphthalein and methyl orange as indicators, is not exact and gives higher results when the "total" acidity is determined. Deviation from the true composition of the solution differs in relation to the quantity of foreign cations present in the preparation. It is necessary to develop a more accurate method of control of the composition of the bath. Application of an iron-manganese phosphate preparation has a number of advantages over manganese alone (minimum duration of the phosphatization, high resistance of the coating to corrosion). A positive effect is also obtained by the mechanical admixture of metallic iron to the preparation (cast iron filings, steel filing), especially in the presence of aluminum salts in the preparation. Among the definitely harmful admixtures are the salts of aluminum, arsenic and lead. The negative effect of aluminum salts can be eliminated to a considerable degree by introduction of iron into the preparation or bath. Nor does it show up on repeated phosphatizations (self-purification of the bath). Presence of noticeable quantities of the salts of arsenic and lead in the preparation is not permissible. Sodium silicofluoride, monocalcium phosphate, and sodium sulphate do no harm in the preparation. There are contradic-

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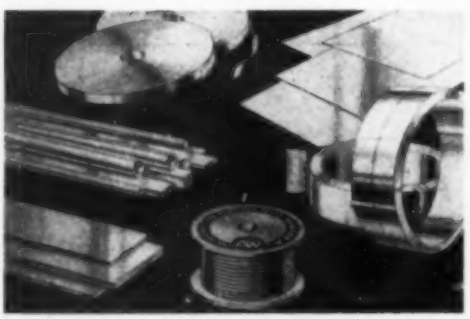

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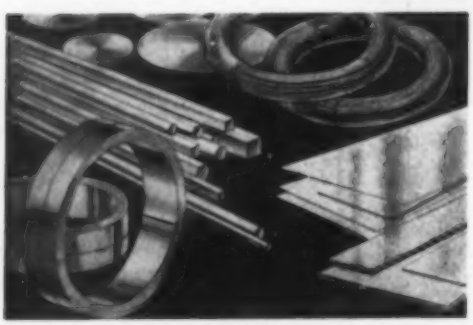

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tory data in regard to the effect of chlorides, so that question remains to be cleared. Calcium sulphate in large quantities has a bad effect on the results of phosphatization, reflecting on the resistance of the coating to corrosion. Since monocalcium phosphate has no bad effect, it is possible to eliminate the calcium sulphate from the phosphoric acid (or the bath) by precipitation of the SO_4 ion with barium carbonate.

Digest from "Effect of the Composition of Phosphorus-Manganese Preparations on the Phosphatization of Steel Parts," by A. A. Sokolovsky and Z. M. Koulagina, *Zhurnal Prikladnoi Khimii* XVIII, No. 7-8, 412-419, 1945. (Published in Russia.)

POLYMERIZATION OF DIHYDROANTHRACENE

DIHYDROANTHRACENE was polymerized in acetic anhydride by exposing a solution of 1 g. of this compound in the solvent to sunlight in the presence of air for 145 days. A crystalline precipitate is formed which melts at 270 deg. C. Addition of a few drops of water to the filtrate produces another precipitate which melts at 190 deg. C., and is accompanied by another amorphous substance which looks like a resin. The two substances recrystallize in boiling acetic acid, the first melting at 275 deg. C. and the second at the same temperature. Addition of water to the filtrate of the first results in another precipitate which melts at 210 deg. C., and addition of sufficient water to the new filtrate precipitates another substance which has a melting point of 110 deg. C. Addition of water to the filtrate of the second results in a precipitate which melts at 246 deg. C. and which leaves a yellow colored ring in the capillary which indicates the quantity of anthraquinone, which is found to be 68 percent.

Digest from "Study of the Polymerization of Anthracene," by H. E. Ocampo, *Quimica* IV, No. 3, 70-73, 1946. (Published in Mexico.)

CHROME MINERALS IN FRANCE

ALTHOUGH France is not a large producer of chromium, there are a number of interesting deposits which are worth considering. Chromium is well known in the Alps and especially in the high valleys of the Ubaye and the Aigue Blanche where serpentine forms innumerable dikes in the midst of calcareous schists. Marble quarries in that region contain so many nodules of chrome iron that there is difficulty in finding perfect blocks of marble. Further to the north, in the high valley of the Arve, chrome iron has been found in the asbestos mines of Termignon and Lanslebourg. Chromite has also been discovered in the old silver mines of Chalanches. Although there are mostly trachytic or basaltic eruptions in the Central Plateau, chrome iron has also been found, but the discovery has not been taken advantage of. There are numerous veins of ophites in the Pyrenees but it is not known whether they contain chromium or not. There are many serpentine deposits in France and a large proportion of these have been found to be chromiferous, but it remains to be seen to what extent these deposits can be developed industrially.

Digest from "Chrome Minerals in France," by V. Charrin, *Chimie et Industrie* 55, No. 4, 305-306, 1946. (Published in France.)

CHEMICAL ENGINEER'S BOOKSHELF

LESTER B. POPE, Assistant Editor

COPPERHILL, TENN.

DUCKTOWN BACK IN RAHT'S TIME. *By R. E. Barclay. The University of North Carolina Press, Chapel Hill.* 270 *pages.* $5.

THIS is a history about an area in Tennessee that is familiar to engineers and chemists who have been employed at some time or other in their lives at Ducktown or Copperhill. This author covers the era from back in the 1830's to 1890. It is the era often referred to as "back in Raht's time" for during those years Captain J. E. Raht was the outstanding figure in the district.

Bound up in this imperishable phrase are history, legend, and stories of early settlers, speculators, miners, mining companies, merchants, mail carriers, rods, schools, and churches—each of which played a leading role at Ducktown in the years preceding the present era. Forgotten through many of them may be, they were once of flattering importance.

ROUNDUP

COLLOID CHEMISTRY, VOL., VI. *Edited by Jerome Alexander. Reinhold Publishing Corp., New York.* 1,215 *pages.* $20.

Reviewed by F. C. Nachod

This volume rounds up the great undertaking and completes what is probably the most comprehensive work on colloids of our times. The sub-title of the volume is "General Principles and Specific Industries, Synthetic Polymers and Plastics." There are 71 papers in the book; the first part relating to general principles and specific industries comprising 38 articles, while the remaining 32 papers cover polymers and certain plastics. Space does not permit citing all contributors and articles. Suffice it to say, that most papers are good reviews of the specific fields augmented with references of the literature. Length and content of the various chapters vary over a wide range. For example, much information can be found in the 104 pages on phycocolloids but little in 1½ pages on casein plastics.

Compliments are due to the editor and to his contributors for doing such a service to their fellow scientists.

TECHNICAL FRENCH

ENGLISH-FRENCH AND FRENCH-ENGLISH TECHICAL DICTIONARY. *By Francis Cusset. Chemical Publishing Co., Brooklyn.* 590 *pages.* $5.

Reviewed by M. G. Callaham

This dictionary is supposed to cover many fields well, although it has a fairly limited vocabulary in chemistry. More attention is devoted to idioms than to simple terms of one word. "Fonte," for example, is translated as "cast iron," whereas it actually has at least 15 additional meanings, any of which might be needed by the user of a technical dictionary. The book does not contain as many different idioms as it seems to at first sight. Each idiom is a separate entry, and such a system always occupies almost twice as much space as listing idioms in a paragraph under the key word. Repetition also helps increase the size of the dictionary. For example, "epuisement d'un gisement de minerai," translated as "exhaustion of an ore body" is indexed under both epuisement and gisement. This long phrase (it can hardly be called an idiom) therefore occupies six lines instead of three. Almost all of the more than 30 idioms under "test" are listed both under test and the accompanying word. This may help in the more rapid use of the dictionary, but in that case it should have been done with greater consistency.

DEVELOPMENTS

CURRENTS IN BIOCHEMICAL RESEARCH. *Edited by David E. Green. Interscience Publishers, New York.* 486 *pages.* $5.

Reviewed by Linus Pauling

BIOCHEMISTRY, which straddles the two two great fields of biology and chemistry, is one of the broadest of all sciences, and it is especially difficult for the worker interested in this subject to keep abreast of developments. In the collection of 31 essays edited by Dr. Green, the leading workers in the field have described the recent developments in their fields and have discussed the probable course of future progress. The essays are in general throughtful, well planned, and carefully written; and the book can be warmly recommended to the interested reader.

The gene and biochemistry are discussed by G. W. Beadle, viruses by W. M. Stanley, photosynthesis by H. Gaffron, and the bacterial cell by R. J. Dubos. Vitamins are treated by C. A. Elvehjem and by Karl Folkers, nutrition and plant biochemistry by D. R. Hoagland, quantitative methods by D. D. Van Slyke, enzymes by D. E. Green and S. Ochoa, and hormones by the famous Argentinian B. A. Houssay. J. S. Fruton and Fritz Lipmann discuss enzymic hydrolysis and peptide bond synthesis, and metabolic process patterns, respectively. L. Michaelis summarizes the work on oxidation-reduction reactions, and H. M. Kalckar the significance of resonance in biology. Several techniques are treated in detail: viscometry by M. A. Lauffer, isotope techniques by D. Rittenberg and David Shemin, x-ray diffraction by I. Fankuchen and H. Mark. Karl Meyer writes on mucolytic enzymes, K. Bloch on the intermediary metabolism, Gregory Pincus on the steroid hormones, and K. V. Thimann on plant hormones. Among other subjects treated are chemical mechanism of nervous action, by D. Nachmansohn; biochemical antagonism, by D. W. Woolley; chemotherapy, by R. D. Hotchkiss; pharmacology, by A. D. Welch and Ernest Bueding; physiology and biochemistry, by C. H. Best; social aspects of nutrition, by W. H. Sebrell; and organization and support of science in the United States, by L. C. Dunn.

RECENT BOOKS RECEIVED

The Chemistry of Heterocylic Compounds. By A. A. Morton. McGraw-Hill. $6.

Contribution to the Physics of Cellulose Fibres. By P. H. Hermans. Elsevier.

Finishing Metal Products. 2nd ed. By H. R. Simonds and A. Bregman. McGraw-Hill. $4.

The Industrial Republic. By P. W. Litchfield. $4.

Theory and Practice of Filtration. By G. D. Dickey & C. L. Bryden. Reinhold. $6.

GAS ENGINEERING

PROCEEDINGS OF AMERICAN GAS ASSOCIATION 1945. *Published by The American Gas Association, 420 Lexington Ave., New York 17, N. Y.* 449 *pages.* $3 *to members;* $7 *to nonmembers.*

THIS is the annual printing of technical paper presented to A.G.A. during 1945. It represents the only printing of much of this material. The volume is, therefore, a "must" item for libraries which undertake to have a complete record of fuel technology.

KNOW-HOW

MANUAL FOR WATER PLANT OPERATORS. *By A. A. Hirsch, Chemical Publishing Company, Inc., Brooklyn.* 386 *pages.* $6.50.

Reviewed by Sheppard T. Powell

THIS practical manual for water plant personnel contains a detailed discussion covering many of the operating problems commonly encountered in water treatment plants, particularly municipal plants. The various types of water treatment processes are discussed in simple language, with a minimum amount of theoretical explanation. The chemistry of water treatment and the theoretical explanation of most of the reactions involved have not been described in detail but this probably will be of minor concern to the practical operator.

Although the absence of theoretical information does not serve as a recommendation to specialized engineers and chemists interested in this phase of the subject, this deficiency does not detract from the value of the manual or the purpose for which it was intended. Generally, every effort has

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been made to present a clear picture of the problems that have been discussed so that an operator requiring advice may refer to the manual for definite solutions. Water treatment know-how, gained only by experience, has been assembled in one place for ready reference. Simple plant arithmetic and the maintenance of records are covered in the text, and a brief review of water treatment plant policy with regard to the service rendered to consumers.

This manual is recommended for the libraries of all water treatment plants and for others interested in the practical phase of the problem.

MEASURING RADIATION

ELECTRON AND NUCLEAR COUNTERS: THEORY AND USE. *By Serge A. Korff. D. Van Nostrand Co., New York. 212 pages. $3.*

Reviewed by G. F. Kinney

THIS volume is a timely contribution for workers in nuclear physics and radiology. It gives an authoritative, simple, straightforward account of fundamental methods of measuring ionizing radiation.

The conventional Geiger counter is thoroughly analyzed and described, as well as the modifications required to prepare special purpose counters selectively sensitive to neutron, alpha particle, or other types of radiation. Operation as an ionization chamber, as a proportional counter, and as a Geiger counter is considered from the viewpoint of the discharge mechanism involved. This theoretical material, judiciously selected, indicates why counters have been made into reliable and reproducible instruments, and should serve to dispel the last thoughts of "black magic" and "secret recipe" that were once prevalent in this field.

One chapter considers the practical aspects which are discussed from both the operational and constructional viewpoints. Another chapter gives a short analysis of the limitations of the counter and its possible errors. The final chapter deals with the electronic auxiliaries used with modern counters, a complete grasp of which would require some familiarity with vacuum-tube circuits.

More than two hundred references add to the usefulness of the volume. It is highly recommended for students and investigators in nuclear physics and all its applications in many and diverse fields such as chemistry, medicine, engineering and biology.

VOLUMINOUS No. 2

TEXTBOOK OF PHYSICAL CHEMISTRY. *Second edition. By Samuel Glasstone. D. Van Nostrand Co., New York. 1,320 pages. $12.*

Reviewed by F. C. Nachod

DR. GLASSTONE'S voluminous treatise appeared first in September 1940 and underwent a number reprintings in quick succession. Now after four years the second edition has come out, increased by 31 pages and 2 figures. The text has not been altered materially and the list of contents will show the arrangement of the book: atomic structure and atomic spectra, radioactivity and isotopes, first and second laws of thermodynamics, the gaseous

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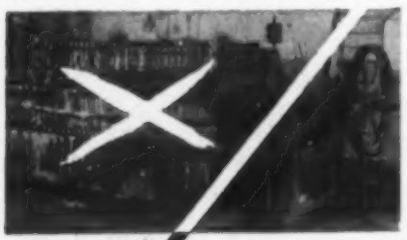

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state, the solid state, changes of state, the liquid state, physical properties and molecular structure, dilute solutions, phase equilibria, chemical equilibrium and free energy, electrochemistry, chemical kinetics, surface phenomena.

The major revision has been made in chapter III, where more commonly used thermodynamic symbols are now employed, and energy is now denoted by the familiar symbol E instead of the U of the older edition.

Glasstone's book is an extremely useful text and has already made many friends. The second edition will no doubt widen the audience of Glasstone's readers.

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RECENT BOOKS and PAMPHLETS

Distillation Bibliography. Engineering Experiment Station Series No. 62, published by Virginia Polytechnic Institute, Blacksburg, Va. 50 pages. 50 cents. 584 items briefly abstracted.

Tables of Fractional Powers. Prepared by the Mathematical Tables Project under sponsorship of National Bureau of Standards. Published by Columbia University Press, Morningside Heights, New York. 489 pages. $7.50. Five tables of A^x and four tables of x^a where a is $\pm \frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{3}$ and $\frac{2}{3}$.

How to Obtain a Surplus. Published by the N. Y. Journal of Commerce, 63 Park Row, New York 15, N. Y. 25 cents. All types of products and materials including chemicals.

Experimental Plastics and Synthetic Resins. By G. F. D'Alelio. Published by John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. 185 pages. $3. A replacement for "Laboratory Manual of Plastics and Synthetic Resins" by the same author; 124 experiments and test methods.

1946-47 Modern Packaging Encyclopedia. 122 East 42nd St., New York 17, N. Y. 1,036 pages. $5. Materials, methods, machines.

Memorandum on Patent Law Reform. Published by The Association of British Chemical Manufacturers, 166 Picadilly, London, W.1. 117 pages. Price 3s. Reforms considered necessary in the (British) Patent Acts.

Modern Development of Chemotherapy. By E. Havinga, H. W. Julius, H. Veldstra and K. C. Winkler. Published by Elsevier Publishing Co., New York. 175 pages. One of a series of monographs on the progress of research in Holland during the war. Sulfonamides and *p*-amino benzoic acid—bacteriological, physico-chemical, chemical, pharmacological, immunological and clinical investigations.

Where to Find Information on the German Chemical Industry. By L. W. Greene, 54D Oak Grove Drive, Baltimore 20, Md. 40 pages. $1. A bibliography of published ma-

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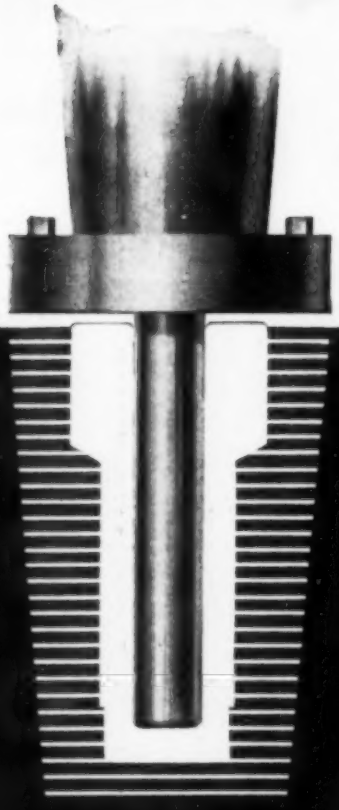

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The Processing of Domestic Flax for Textile Use. By J. L. Taylor. Bulletins 9 & 10, published by State Engineering Experiment Station, Georgia School of Engineering, Atlanta, Ga. 28 & 24 pages. 75 cents each. No. 1, Decortication; No. 2, Retting and degumming.

Transportation: Principles and Problems. By T. C. Bigham. Published by McGraw-Hill Book Co., 330 West 42nd St., New York 18, N. Y. 626 pages. $5. The economics of transportation. Legislation, rate making, service, security issuance, labor, government ownership, public aid and public policy.

American-Made vs. Crude Rubber. By J. L. Collyer, The B. F. Goodrich Co., Akron, Ohio. 31 pages. An appraisal of supply, progress, costs and outlook for the two kinds of rubber a year after the war's end. Recommends early establishment of free competition between them.

Atomic Key to the Future. By L. Hartley. Distributed by National Committee on Atomic Information, 1749 L St., Washington 6, D. C. 14 pages. 10 cents. Implications of the United States proposals for international control of atomic energy.

Construction of Nomographs With Hyperbolic Coordinates. By W. H. Burrows. Reprint No. 17, published by State Engineering Experiment Station, Georgia School of Technology, Atlanta, Ga. 6 pages. A coordinate system which allows flexibility of position and modulus of the various scales necessary in the construction of nomographs.

Oregon Minerals Map. Published by the State Dept. of Geology and Mineral Industries, 702 Woodlark Bldg., Portland 5, Ore. 10 cents. A 22x34-in. map showing the location of over 300 chemical and other mineral deposits of the state. Principal localities of 43 minerals are shown and brief explanatory notes describe 12 of the most important ores.

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Synthetic Organic Chemicals, United States Production and Sales, 1945. U. S. Tariff Commission. Preliminary report. Mimeograph.

Mining and Manufacturing Industries in Mexico. U. S. Tariff Commission. Price 25 cents.

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War-Plants Disposal: Bids for Big Inch and Little Big Inch Pipe Lines. Report of the Surplus Property Subcommittee of the Committee on Military Affairs. Senate Subcommittee Print No. 11. Available free on request to Senate Document Room, Washington 25, D. C.

Development in Consumers' Cooperative Movement in 1945. Bureau of Labor Statistics, Bulletin No. 859. Price 10 cents.

Animal and Vegetable Fats and Oils 1941-1945. Factory Production, Consumption, and Stocks. Bureau of the Census, Facts For Industry Series M17-7-05, Washinton 25, D. C.

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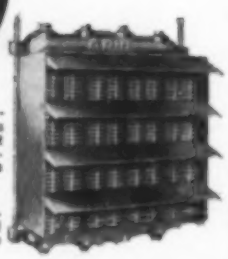

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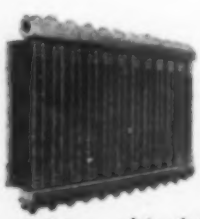

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Collection and Preservation of Insects. By P. W. Oman and Arthur D. Cushman. Department of Agriculture, Miscellaneous Publication No. 601. Price 15 cents.

Acetylated Wood. By Harold Tarkow, et al. Forest Products Laboratory, Madison 5, Wis. No 1593. Processed.

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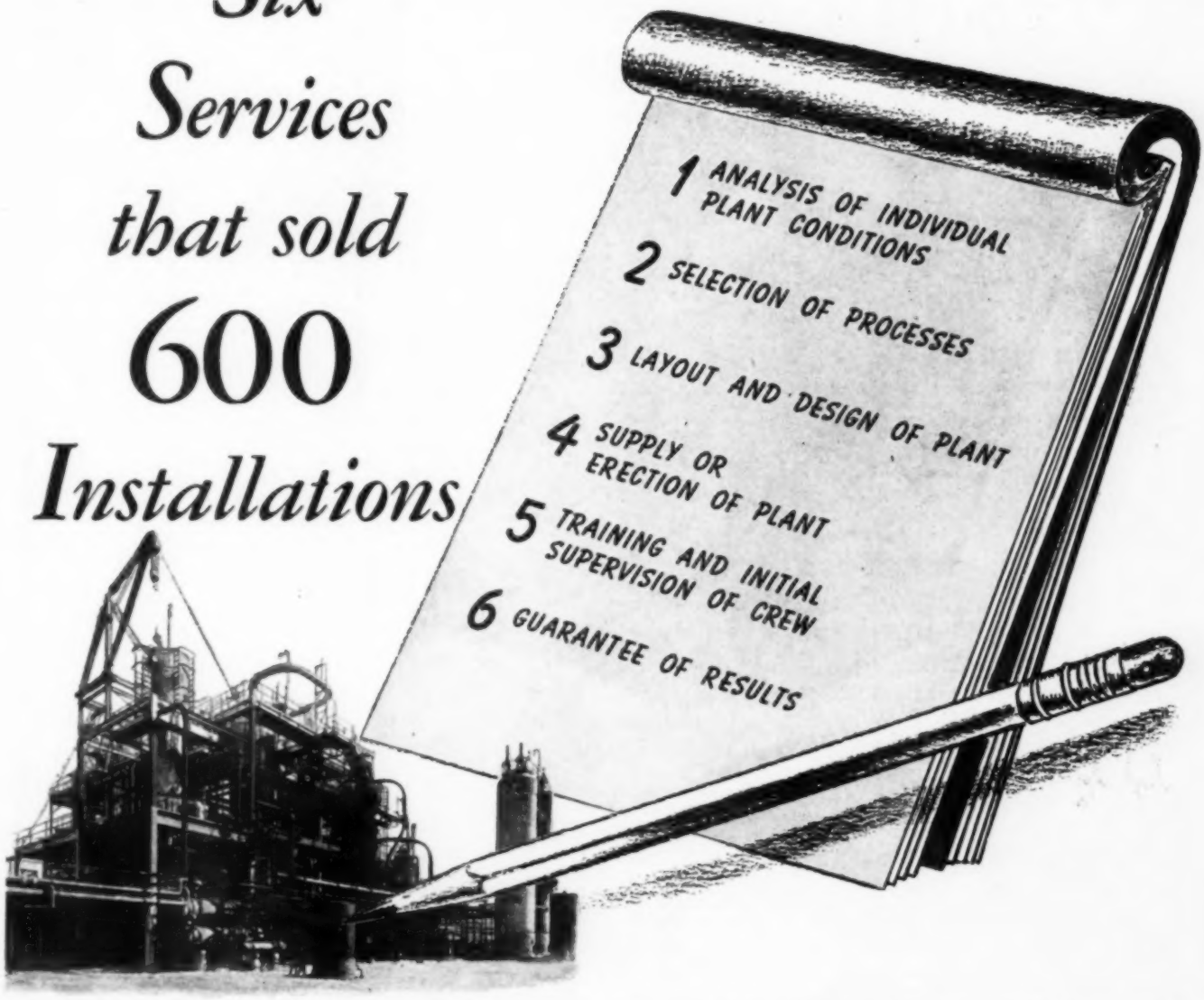
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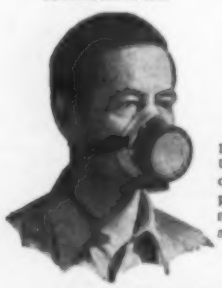

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District, Alaska. By R. E. Van Alstine, et al. Geological Survey Bulletin 947-G. Price 15 cents.

Contributions to Geochemistry 1942-45. By R. C. Wells and others. Geological Survey Bulletin 950. Price 40 cents.

Bibliography of Bureau of Mines Publications Dealing With Health and Safety in the Mineral and Allied Industries. By Sara J. Davenport. Bureau of Mines. Mimeographed.

Foreign Synthetic Liquid Fuels Division Library, Bureau of Mines. A list of publications received up to June 15, 1946 from overseas agencies. Mimeographed.

Report on the Investigation by Fuels and Lubricants Teams at the Wintershall A. G. Lützkendorf, Near Müchelm, Germany. By H. Hollings. Bureau of Mines, Information Circular I. C. 7369. Mimeographed.

Report on the Investigation by Fuels and Lubricants Teams at the I. G. Farbenindustrie A. G. Leuna Works, Merseburg, Germany. Edited by R. Holroyd. Bureau of Mines, Information Circular I. C. 7370. Mimeographed.

Investigation of the Lost River Tin Deposit, Seward Peninsula, Alaska. By H. E. Heide. Bureau of Mines, Report of Investigations R. I. 3902. Mimeographed.

History of Water-Flooding of Oil Sands in North Texas. By Peter Grandone, et al. Bureau of Mines, Report of Investigations R. I. 3906. Mimeographed.

Exploration for Zinc and Lead Ore, Phelps Lease, Jasper County, Missouri. By Louis C. Brichta. Bureau of Mines, Report of Investigations R. I. 3941. Mimeographed.

Diamond Drilling Potash Reserves in Eddy County, New Mexico. By W. R. Storms. Bureau of Mines, Report of Investigations R. I. 3861. Mimeographed.

Exploration of the El Dorado Copper Mine, El Dorado County, Calif. By R. H. Bedford. Bureau of Mines, Report of Investigations R. I. 3896. Mimeographed.

Observations on the Use of a Diesel Freight Locomotive Through a Railway Tunnel. By L. B. Berger and L. H. McGuire. Bureau of Mines, Report of Investigations R. I. 3887. Mimeographed.

Studies on the Flotation of Spodumene from the Edison Mine, Keystone, S. Dak. By Gerald A. Munson and K. L. Erickson. Bureau of Mines, Report of Investigations, R. I. 3892. Mimeographed.

Concentration of Fluorite from Metals Reserve Company Stock Piles. By M. M. Fine, W. A. Calhoun, and R. G. O'Meara. Bureau of Mines, Report of Investigations R. I. 3893. Mimeographed.

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Why Child Labor Laws? By Lucy Manning. Department of Labor, Children's Bureau, Publication No. 313. Price 5 cents.

DDT for Control of Household Insects Affecting Health. Public Health Service. Price 10 cents.

Report of the President's Committee on the Cost of Living. Office of Economic Stabilization. Price 60 cents.

Fourth Report of Operations Under the Boulder Canyon Project Adjustment Act for Year Ended May 31, 1945. Bureau of Reclamation. Price 10 cents.

Geology as a Profession. National Roster of Scientific and Specialized Personnel, Vocational Booklet No. 1. Price 10 cents.

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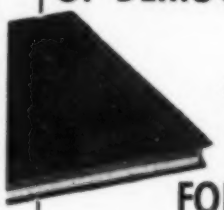

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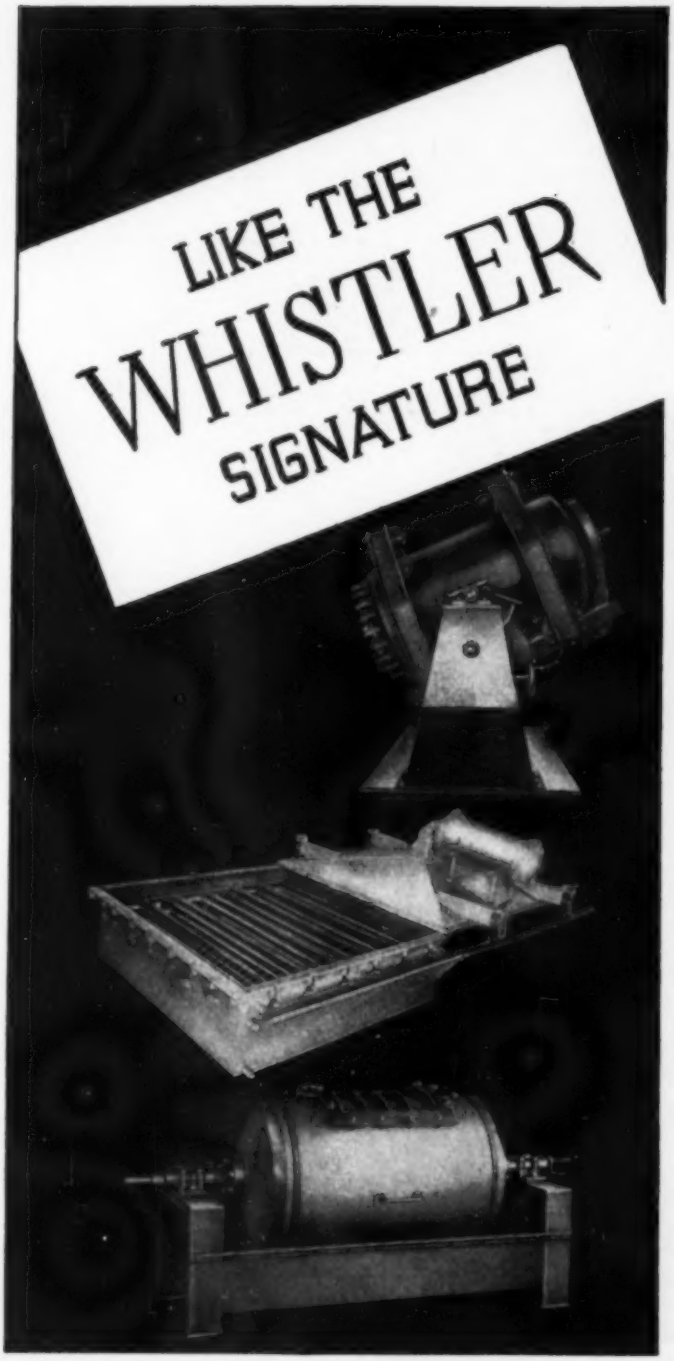

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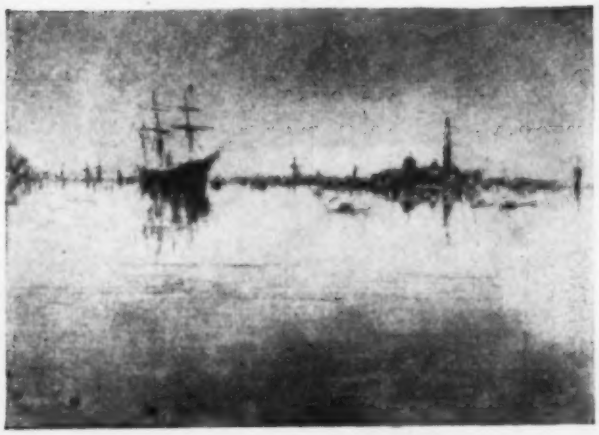

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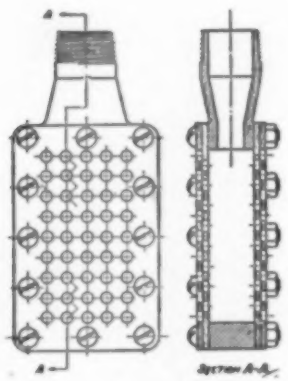

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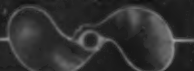

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2

Chemicals. Hercules Powder Co., Wilmington, Del.—8-page booklet entitled Rosin Rubber which discusses the application of Dresinate No. 731, a sodium soap of a modified resin, derived from wood resin. It is used in synthetic rubber.

3

Chemicals. Paragon Testing Laboratories, Orange, N. J.—4-page catalog listing the fine organic chemicals available from this company. Contains information on grades, properties, and includes prices.

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Chemical Feeders. Fuller Co., Catasauqua, Pa.—Bulletin F-2. 8-page booklet illustrating and describing various types of feeders for handling dry, pulverized, finely crushed and granular materials.

5

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6

Compressors. Worthington Pump and Machinery Corp., Harrison, N. J.—Bulletin L-680-B1A. 32-page illustrated booklet describing the steam-driven opposed type compressors equipped with feather valves. Construction details are illustrated and various accessories are shown. Bulletin L-640-B1A. 24-page booklet illustrating and describing the Type HB single horizontal compressor. Also Bulletin W-350-B5A, which is an 8-page folder describing various Worthite specialties including valves, pipes, flanges, hose nipples, castings, bars, forgings, wire, welding electrodes, and screw machine products.

7

Condenser Tubes. Wolverine Tube Div., 1411 Central Ave., Detroit, Mich.—16-page booklet illustrating and describing the condenser tubes manufactured by this company. Table of alloys available for condenser tube use, their chemical and physical characteristics, as well as a section of corrosion. Also contains information on finned tubes, as well as a table of weights for the various sizes of tubes.

8

Conveyors. The Rapids-Standard Co., Inc., Grand Rapids 2, Mich.—4-page leaflet illustrating and describing the Rapid-Roller gravity conveyor, made by this company. Also a two-page step-by-step lubrication chart for standard gear motors on Rapids-Standard power belt conveyors has been recently issued and is now available.

9

Electric Equipment. Electric Specialties Co., Stamford, Conn.—Catalog 46-1. 4-page illustrated folder describing electric equipment such as motors, dynamometers, motor generator sets, etc.

10

Electric Equipment. Herbach and Rademan, Philadelphia, Pa.—8-page price list of equipment including Geiger-Muller counters, meters of various kinds, and other electrical and electronic equipment.

11

Electric Motors. Crocker Wheeler Electric Mfg. Co., Ampere, N. J.—Bulletin SL-300-3. 2-page leaflet illustrating and describing the round frame protected-type motors for close couple service, available from this company.

12

Equipment. Fluor Corp., Ltd., Los Angeles, Calif.—Catalog No. 46. 20-page booklet featuring various types of equipment including cooling towers, fin-fan cooling units, gas cleaners, mufflers, and other equipment.

13

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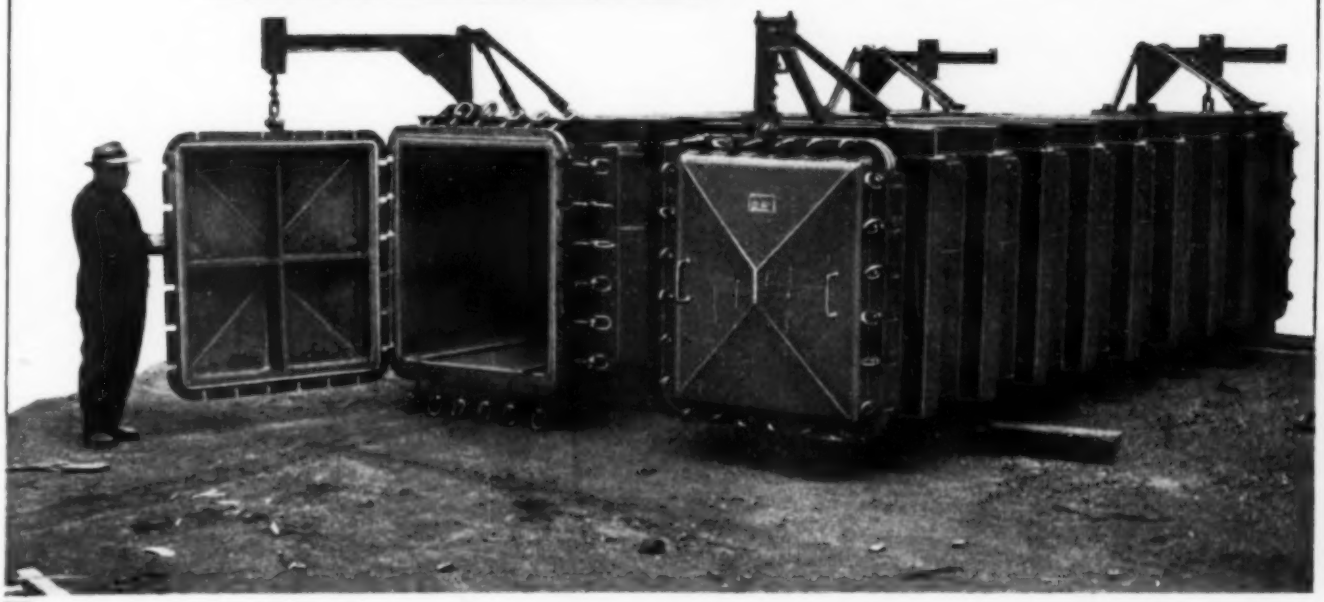

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14

Filters. Davis Filtration Equipment Co., Inc., New York, N. Y.—12-page loose-leaf catalog describing the Clear-flow 200 series of pressure leaf-type filters. Designed for removal of colloidal types of turbidities. Includes schematic diagrams of simplex and duplex operations, cross-sectional diagrams, and illustrations of both portable and stationary models.

15

Filters. Selas Corp. of America, Philadelphia, Pa.—8-page booklet describing and illustrating pressure filters which utilize micro-porous filter media for continuous production of pharmaceutical, bacteriological, biological, fine chemical, and food filtrations.

16

Furnaces. Ajax Electric Co. Inc., Philadelphia, Pa.—Reprints of two technical articles. One is entitled "Sodium Hydride Descaling" and the other "Sodium Hydride Descaling and Desanding of Ferrous Castings and Forgings."

17

Furnaces. Hevi Duty Electric Co., Milwaukee, Wis.—Bulletin HD-646. Booklet illustrating and describing the carburizer nitrider. Includes data on construction, carburizing processing gases, carburizing procedures, nitriding procedures, and other uses of this equipment.

18

Graphite. Acheson Colloid Corp., Port Huron, Mich.—Booklet describing colloidal graphite which gives data on the properties, and applications for colloidal graphite. Describes and illustrates dispersions in oil, volatile hydrocarbon dispersions, dispersions in alcohol, and other special dispersions.

19

Heat-Transfer. Cochrane Corp., Philadelphia, Pa.—Publication No. 3250. 16-page booklet featuring the Cochrane system for increasing heat transfer rates in steam process equipment. The principle of operation is illustrated and described, and the application of this system in various industries is shown.

20

Hydraulic Equipment. Hydro-Power Inc., Springfield, Ohio.—9-page illustrated booklet describing hydraulic equipment such as radial pumps, gear pumps, boosters, valves, and packaged power units. Includes cutaway views which show details of construction plus dimensional sketches.

21

Hydraulic Presses. Air-Hydraulics, Inc., Chelsea, Mich.—8-page booklet illustrating and describing the Air-Hydraulic press made by this company. Includes specifications.

22

Insecticide. Pennsylvania Salt Mfg. Co., Philadelphia, Pa.—4-page pocket size leaflet describing Erusto DDT emulsion for use in laundry and dry-cleaning plants.

23

Instruments. The Brown Instrument Co., Philadelphia, Pa.—Bulletin No. B59-2. 12-page technical bulletin entitled "Pneumatic Transmission of Instrument Readings Over Long Distances." Engineering data is illustrated with graphs and a summary of recommendations is included.

24

Instruments. Builders Providence, Inc., Providence, R. I.—4-page leaflet featuring this company's recording, indicating and controlling instruments.

25

Instruments. The Foxboro Co., Foxboro, Mass.—Bulletin 381. Bulletin describes the new Model No. 40 controller, the newest addition to this company's line of instruments for process control. Includes data on fentures of design, construction, and operation.

26

Instruments. Northern Equipment Co., Erie, Pa.—Bulletin 459. 8-page booklet illustrating water level control for boilers.

27

Ion-Exchange. American Cyanamid Co., New York, N. Y.—8-page booklet illustrating and describing this company's ion-exchange units for producing potable water. Includes operating data on a typical successful application of the equipment in supplying water. It lists the specifications for the standard models available including the portable unit. Mechanical and chemical theories are explained with the aid of schematic drawings and flow diagrams.

28

Ion-Exchange. Process Equipment Corp., Chicago, Ill.—4-page folder featuring the deionization equipment manufactured by this company. Contains information on the purification

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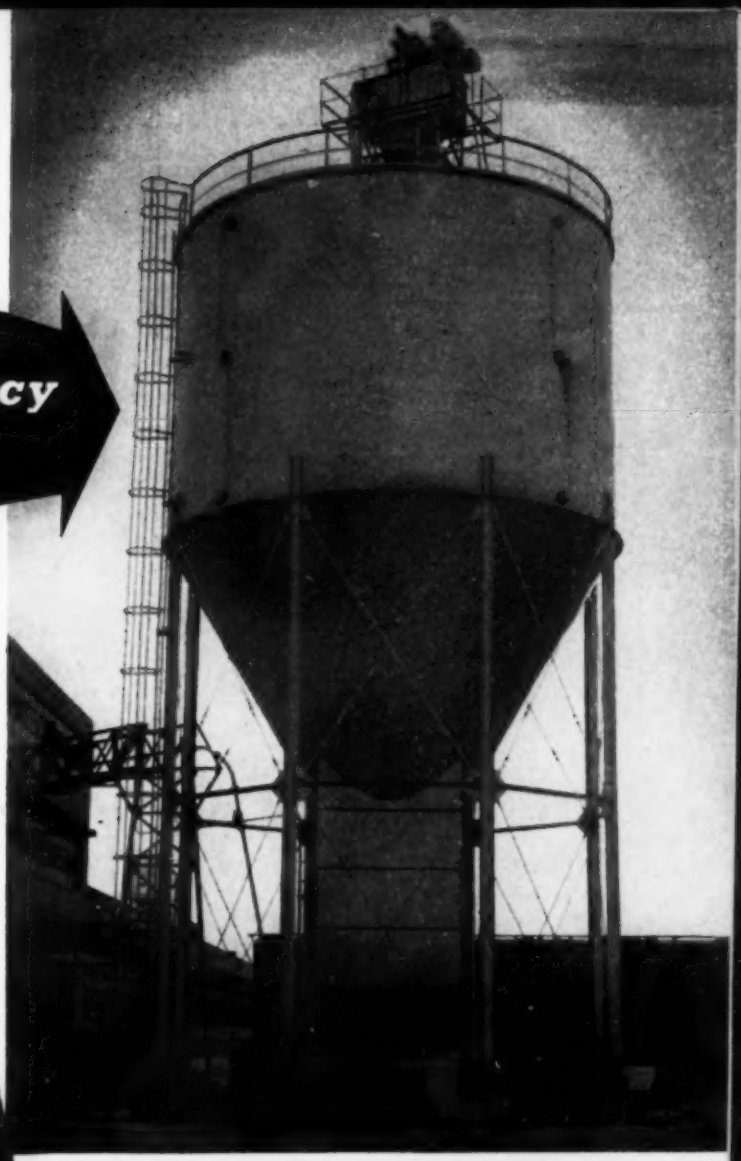

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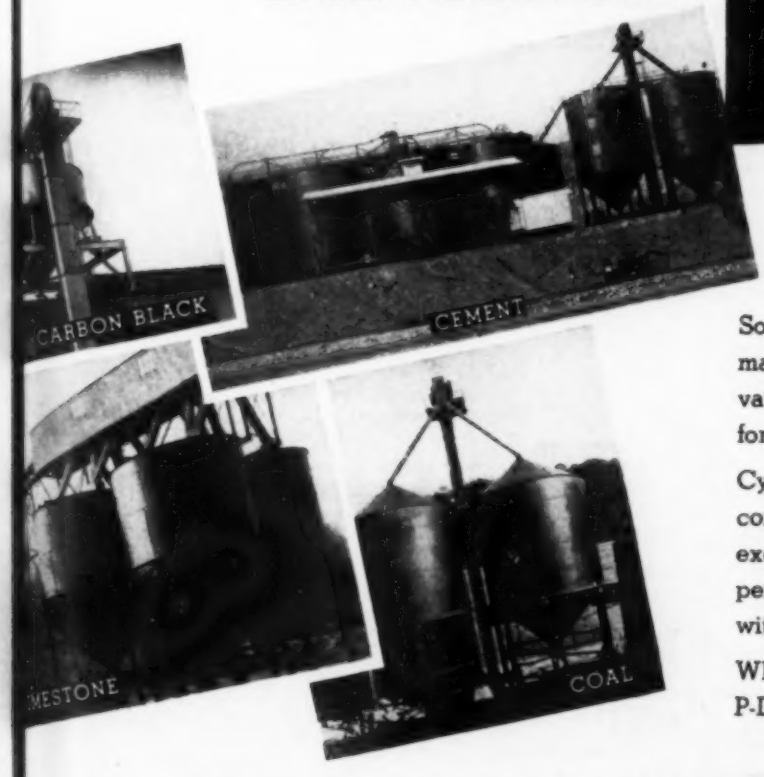

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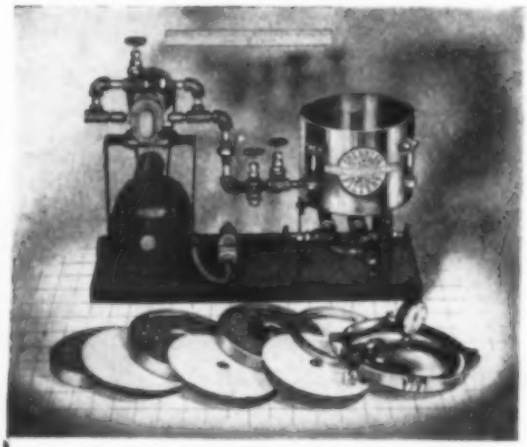

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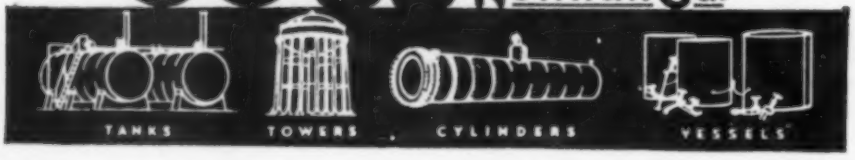


of water by this method, as well as information on operations, costs, rosins, and other details.

29

Jet Equipment. Schutte & Koerting Co., Philadelphia, Pa.—Bulletin J-1. 40-page illustrated booklet featuring industrial applications of various kinds of jets. Includes sections on the description of jet action, jet design and applications. The book is liberally illustrated with diagrammatic sketches using two or more colors for illustrating the flow of liquids. It is an excellent presentation of the subject.

30

Lubrication. Sun Oil Co., Philadelphia, Pa.—Bulletin No. B-1. 48-page booklet entitled "Lubrication of Diesel Engines." Includes section on development of the diesel engines, common types of diesel engines, cylinder and bearing lubrication, lubricating oil recommendation, and other interesting information.

31

Materials Handling. Traylor Engineering & Mfg. Co., Allentown, Pa.—Bulletin No. 114. 10-page booklet describing and illustrating the crushers and feeders made by this company. Includes data on mill feeders, table feeders, and slurry feeders.

32

Pipe Bender. Watson-Stillman Co., Roselle, N. J.—Bulletin No. A-7. 8-page booklet illustrating and describing the W-S portable hydraulic pipe bender.

33

Pipe Fittings. Tube Turns, Inc., Louisville, Ky.—Designed for use by those concerned with the buying, design, layout and erection of piping systems is the chart of pipe and fittings materials available from this company. It deals with carbon, intermediate alloy, stainless and special analysis steels, and covers ASTM specifications, chemistry, service limitations and welding procedure.

34

Pilot Valves. Fisher Governor Co., Marshalltown, Iowa.—Bulletin D-2. 8-page booklet illustrating the snap-action Wizard pilot, Series 4101 for on and off pilot operated pressure control service.

35

Plastic Coating. American Pipe and Construction Co., Los Angeles, Calif.—8-page technical bulletin giving information on the entire Amercoat line of plastic coatings used in corrosion protection. Contains tables of properties, applications, and industrial uses.

36

Power Transmission. D. O. James Mfg. Co., Chicago, Ill.—Catalog No. 1,000, a bound book containing a collection of nine catalogs, featuring such subjects as continuous tooth herringbone gear speed reducers, planetary gear speed-reducers, angle spiral bevel gear speed-reducers, motorized gear speed-reducers, flexible couplings, and engineering data.

37

Power Transmission, Philadelphia Gear Works, Inc., Philadelphia, Pa.—56-page booklet illustrating and describing spiral-bevel speed reducers. Includes data on design features, lubrication, table of load characteristics, and other information regarding this equipment. Bulletin No. 200.

38

Protective Coating. The Merchants Chemical Co., Stamford, Conn.—4-page bulletin describing Cordo-Clad 1060, which is a plastic base solvent type air drying protective coating. Includes data on properties, application methods, and lists a number of coats which must be applied to resist various chemical substances.

39

Pumps. Economy Pumps, Inc., Hamilton, Ohio.—Catalog D-446. 4-page booklet featuring the small high-pressure pumps now available. Includes details of construction, together with performance curves.

40

Pumps. Milton Roy Co., Philadelphia, Pa.—Bulletin No. 468. 4-page booklet illustrating and describing automatic proportioning and ratio control systems, automatic pH control systems, and other control systems using Milton Roy pumps.

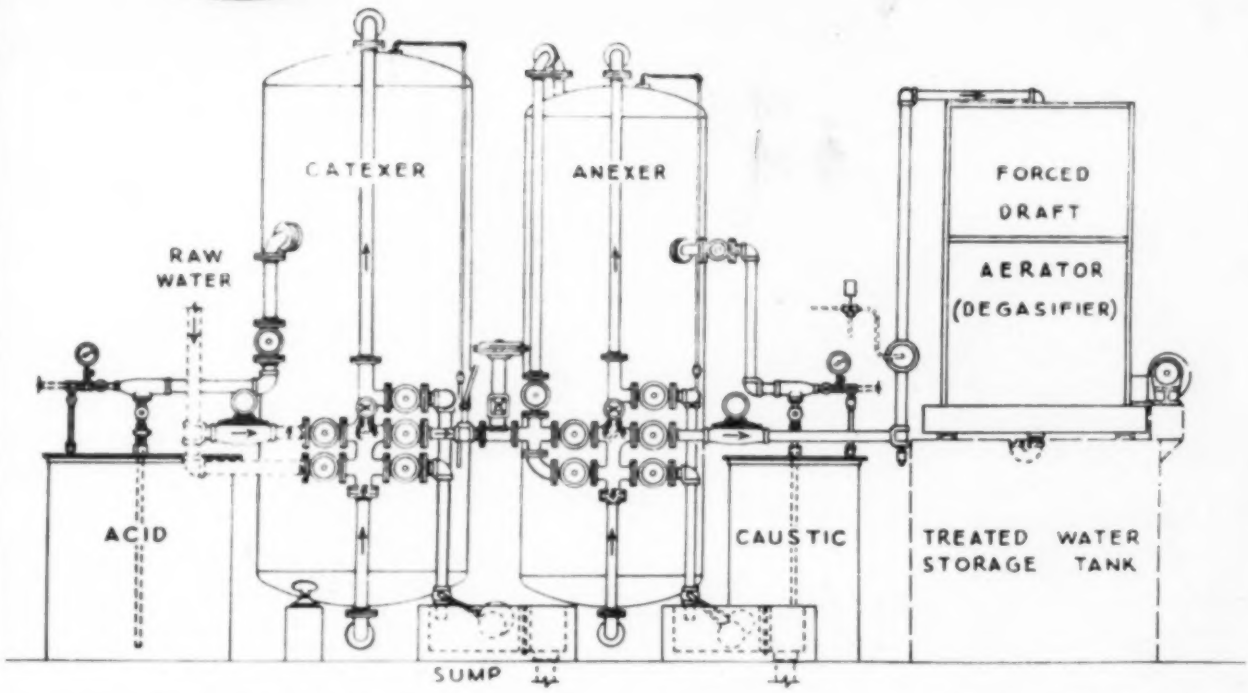
41

Pumps. Viking Pump Co., Cedar Rapids, Ia.—Bulletin 203. 4-page booklet illustrating and describing rotary pumps for handling hazardous liquids. Includes table of dimensions and specifications.

42

Pump Seals. Durametallic Corp., Kalamazoo, Mich.—2-page leaflet illustrating and describing the mechanically lubricated Dura Seal for serv-

INFILCO



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It didn't take long, in the chemical industries, for CATEX-ANEX to be known as a producer of things other than pure water alone. First known as the *complete* ion exchange method of treating water, CATEX-ANEX has since been found to be a potential method of treating many an acqueous solution. Now, for instance, possible applications include such widely different jobs as removing formic acid and formates from formaldehyde...recovering tartrates from wine residues...removing metallic impurities from pharmaceutical preparations.

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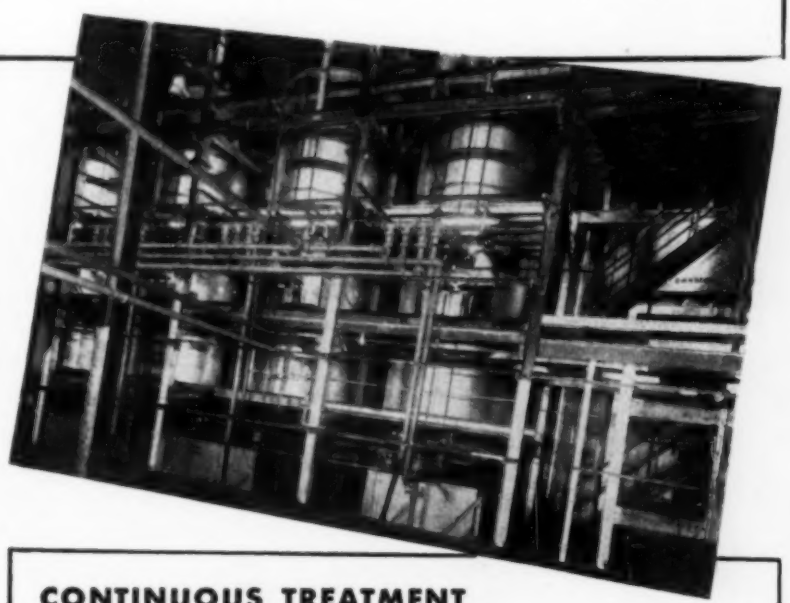

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This large CATEX-ANEX installation operates at capacity rates of 350-400 gallons *per minute*. The four identical units insure continuous operation to meet the steady demand at this plant. Purification need never stop, as a freshly regenerated unit is always ready to carry on.

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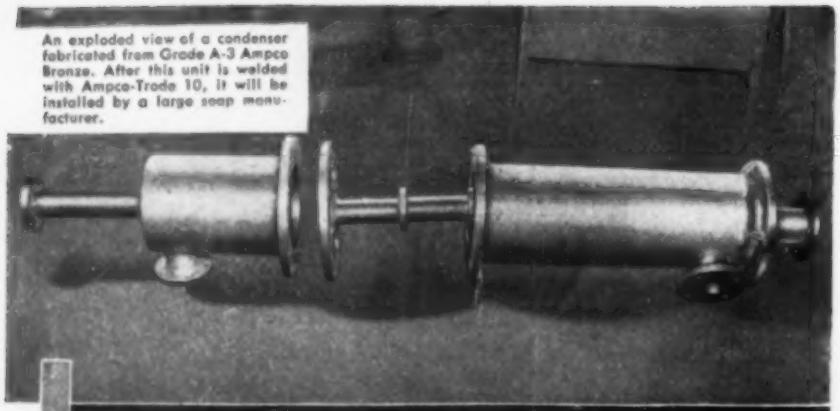

An exploded view of a condenser fabricated from Grade A-3 Ampco Bronze. After this unit is welded with Ampco-Trode 10, it will be installed by a large soap manufacturer.

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AMPCO Metal, an engineered aluminum bronze alloy available in 5 grades, is without equal when it comes to low-cost corrosion- and acid-resistant fabricating. Entire assemblies can be made at Ampco under one roof, from high-strength *Ampco Metal* castings, rolled sheet, and extruded rod. They can be welded with *Ampco-Trode* coated aluminum bronze electrodes that deposit weld metal with the same physical properties provided in the component parts by *Ampco Metal*.

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Not only are fabricating costs lower, but you also save on replacements. The longer life of *Ampco Metal* units reduces "down time" and increases production. Let Ampco help you with your corrosion and acid-resistance problems. There's an experienced field engineer near you — call him in.

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ice at pressures up to 500 lb. Cutaway view shows the various construction details.

43

Refractories. The Ironton Firebrick Co., Ironton, Ohio.—Circular No. 22. 5-page mimeographed circular describing the Ironton Berlite available from this company.

44

Refractory Cement. Quigley Co., Inc., New York, N. Y.—Four-page illustrated booklet featuring the Q-Chromastic plastic super-refractory surfacing mortar available from this company. Information is given on various types of applications. Includes description of how to use this material.

45

Refrigeration. The Mathieson Alkali Works, Inc., New York, N. Y.—32-page illustrated booklet describing the manufacture, distribution and use of dry ice. It features a series of charts estimating the amounts of dry ice required to maintain various temperature in refrigeration units of many different sizes. Includes such factors in dry ice refrigeration as design and packing of truck boxes, bunkers and storage cabinets. Many of the industrial applications of dry ice are described.

46

Refrigeration Equipment. Bowser, Inc., Refrigeration Division, Terryville Conn.—Four new bulletins describing equipment made by this company. This series of booklets cover Bowser laboratory and production testing machines which simulate altitude conditions, including subzero, cold, relative humidity and vacuum conditions.

47

Rubber Products. B. F. Goodrich Co., Akron, Ohio.—Several bulletins are now available from this company on the following subjects: Power transmission belting, cleaning and storing of conveyor belts, Flexseal hose joints, electrically heated rubber, industrial fire protection.

48

Rust Preventatives. Nox-Rust Chemical Corp., Chicago, Ill.—24-page brochure describing the various products made by this company.

49

Safety Equipment. Pulmosan Safety Equipment Corp., Brooklyn, N. Y.—36-page catalog of this company's respiratory equipment including respirators, masks, hoods and helmets for protecting workers.

50

Screens. The Morrow Mfg. Co., Wellston, Ohio.—Bulletin 70. 52-page pocket-size handbook of perforated metal screens. Contains illustrations, data tables, specifications and standard practice information on three types of perforated plate screens—flat, step, conical and cylindrical.

51

Screens. Robins Conveyors, Inc., Passaic, N. J.—Bulletin 111-A. 12-page bulletin illustrating and describing the Eliptex screen manufactured by this company. Principle of operation is given, specifications of the equipment are shown, and the various components of the equipment are described. Applications for wet or dry screening are described. Includes diagrams with dimensions in tabular form.

52

Sight Glasses. Bijur Lubricating Corp., Long Island City, N. Y.—Bulletin 4-B. 4-page folder illustrating and describing the sight glasses or windows for observing operation of internal moving parts, or for observing the liquid level or flow of fluids in industrial equipment.

53

Silicones. Dow-Corning Corp., Midland, Mich.—4-page pocket-sized folder describing the Dow-Corning mold release fluid emulsion No. 35.

54

Silicones. Dow Corning Corp., Midland, Mich.—8-page booklet entitled "Silicone Fluids for Use in High Vacuum Diffusion Pumps." Contains a table of physical properties, vapor pressure curves, a graph of pumping speeds, and other worthwhile information.

55

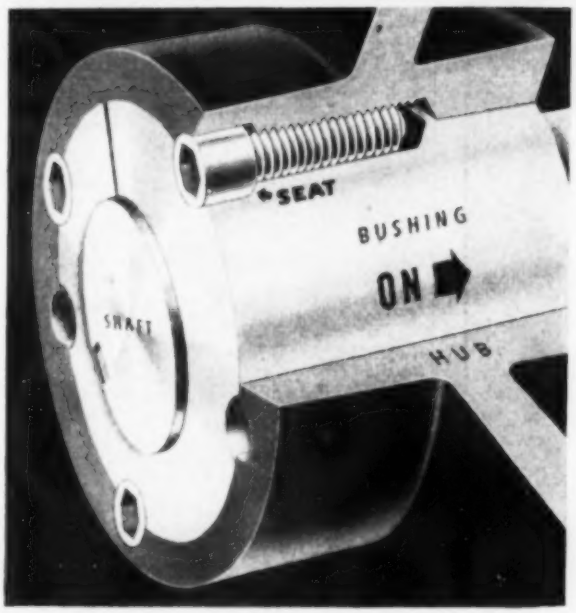
Smoke Disposal. Bituminous Coal Research Inc.—Technical Report No. 7. Booklet entitled "Application of Over-Fire Jet to Prevent Smoke in Stationary Plant" gives information on the elimination of smoke from coal-fired stationary plants such as used in the industry.

56

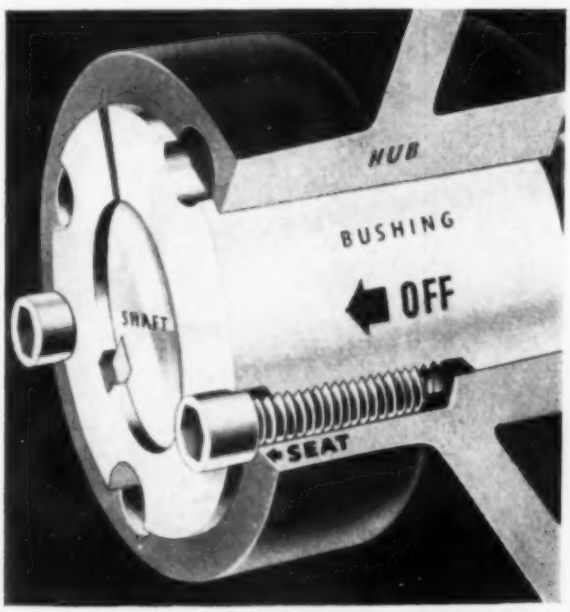
Steam Cleaner. Homestead Valve Mfg. Co., Coraopolis, Pa.—2-page leaflet featuring the Model JO Hypressure Jenny, a steam cleaner made by this company. It is used for cleaning

NEW

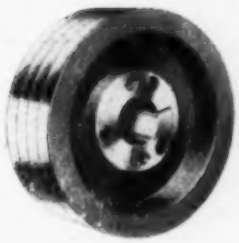
TAPER-LOCK BRAND SHEAVE



Note that only the HUB is threaded. Screw-head seats itself against offset in bushing. As the screw is turned, the sheave is drawn up — wedged — with a firmness equivalent to a shrunk-on fit, whether the shaft is standard or normally undersize.



Note that here only the BUSHING is threaded. Screw-head seats itself against face of hub. As the screw is turned, the wedge is disengaged. Due to its steep taper, the bushing disengages with less effort than in any other sheave. It's easy on — and easy off!



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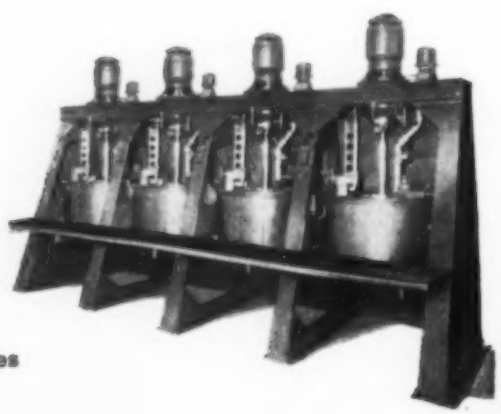

usually one man operates several machines

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57

Spray Nozzles. The Marley Co., Kansas City, Kans.—Bulletin SN 1-46, Bulletin SN 2-46, Bulletin 103-8. Three, 2-page leaflets illustrating and describing the various types of spray nozzles manufactured by this company. These nozzles are used for a wide variety of purposes, including aerating systems, atmospheric condensers, cooling towers, gas scrubbers, spray ponds, washing devices, and water filtering systems. Tables of sizes and dimensions and capacities are given.

58

Stop Watches Meylan Stop Watch Corp., New York, N. Y.—6-page catalog covering the stop watches manufactured by this company.

59

Textile Chemicals. American Cyanamid Co., Bound Brook, N. J.—Bulletin 103 is a 6-page booklet describing Sheerset and Lacet resin finishes and their effect on certain types of fabric. Bulletin 114 describes a dye-staining technique for studying shrinkage control of cotton.

60

Textile Chemicals. Dexter Chemical Corp., New York, N. Y.—8-page booklet entitled "Luster Determination With a Photoelectric Photometer." Explains in detail the steps to be followed in determining the luster of mercerized material, including a description of the apparatus.

61

Tubing. Bridgeport Brass Co., Bridgeport, Conn.—Bulletin No. 746.—10-page illustrated booklet describing duplex tubing, its features and application. Contains a section on installation of duplex tubing. It is used in preventing corrosion by various liquids.

62

Tubing. Pratt Industries, Inc., Frankfort, N. Y.—New booklet describes and illustrates the applications for the spirally formed, light-weight tubing manufactured by this company. Includes tables and test illustrations which compare this tubing with other types.

63

Tubing. Trent Tube Mfg. Co., East Troy, Wis.—16-page booklet featuring stainless steel tubing in sizes from ⅛ to 18 in. in diameter.

64

Underground Pipe Lines. H. W. Porter & Co. Inc., Newark, N. J.—4-page leaflet describing Therm-O-Tile which is a permanent conduit for underground pipe lines. Includes specifications data and describes how it is installed.

65

Ventilating Equipment. The Propeller Fan Manufacturers Association, Detroit, Mich.—New bulletin prepared by the Engineering Committee of this association which sets forth the basic requirements of satisfactory attic ventilation. This booklet entitled "Attic Ventilation Code," should be helpful in planning the ventilation of buildings.

66

Water Treating. The Permutit Co., New York, N. Y. New booklet describes basic types of ion exchange water softeners for industrial, institutional and municipal use. Softeners are of both pressure and gravity types which feature automatic equipment to control backwashing, brining and rinsing processes.

67

Welding. Minweld Steel Co., Pittsburgh, Pa.—4-page illustrated leaflet showing some of the types of all-welded fabrication and construction available from this company. It describes the facilities and services available from this company.

68

Welding. Hollup Corp., Chicago, Ill.—64-page catalog of all Hollup electrodes and oxyacetylene gas welding rods. Included are complete descriptions, color identifications, specifications, physical properties, etc.

69

Weldments. Lukenweld Inc., Coatesville, Pa.—28-page booklet illustrating and describing the design and fabrication of weldments. Various types of equipment made by welding are shown.

70

Wood Products. Timber Engineering Co., Washington, D. C.—18-page booklet entitled "How Research Creates New Markets for Hard Wood." Illustrates and describes various products made from hard wood. Also 4-page folder describing the manufacture and use of laminated wood rolls for use in the manufacture of wall paper and linen.

CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

INDEX FOR INDUSTRIAL CONSUMPTION OF CHEMICALS REGISTERED AN ALL-TIME HIGH IN AUGUST

TAKING THE unadjusted indexes of the Federal Reserve Board as a basis of comparison, production of industrial chemicals has varied but little in the last three months. The index number for June is 389, and the revised number for July is 388, while the preliminary August figure moved up to 390. The production rate for January was established at 384 with April at 392 representing the peak month of the year to date. Hence the trend so far has been upward but the rate of growth has been very moderate, however the monthly average of 386 for the first eight months compares with 375 as representative of activities in the postwar months of last year.

Industrial production in general reached a postwar high of 178 in August and as the index for January was 156, it is evident that the downward trend which started in August 1945, has been reversed. Total production in the final quarter of this year is expected to show up well and the Shippers Advisory Boards have estimated that freight car loadings for that quarter will run 9.8 percent above actual loadings for the like period of last year.

Industrial consumption of chemicals also was higher in August with some of the consuming industries—notably paper and oil refining—reaching their highest levels of the year. The *Chemical Engineering* index for industrial consumption of chemicals is 210.67 for August with 201.43 as the revised figure for July. For the corresponding months of last year the indexes were 187.07 and 184.94 respectively. The index number for August registered an all-time high for consumption of chemicals, replacing the record of 206.27 established last March. The new high was reached despite the scarcity of new materials which curtailed activities in some consuming branches, notably leather and plastics. The outlook for the final quarter of this year favors a 10 percent gain over the 189.36, which represents the average level maintained throughout the October-December period of last year.

While progress is reported in the way of getting replacement parts and new equipment to manufacturing plants, equipment firms are handicapped by delays in obtaining necessary raw materials. Typical of this situation are the findings of one company as of the middle of September, covering delivery dates of materials needed by the company. Earliest delivery dates of some of the materials in question are: carbon steel plates, second quarter of 1947; carbon steel heads, second quarter of 1947; carbon steel tubing, mill deliveries, second and third quarters of 1947; stainless steel, polished finish, February 1947; stainless steel, still finish, around the first of next year; stainless steel tubing, January 1947; stainless steel bar stock, 4 to 5 months; malleable castings, 4 to 6 months; grey iron castings, 2 to 3 months; non-ferrous castings, 5 to 8 weeks; stainless steel castings, 8 to 12 weeks; fractional electric motors, 20 to 24 months; heavy motors, 10 to 12 months; specified gaskets, 8 weeks; gears 6 months; and forgings 6 to 8 weeks.

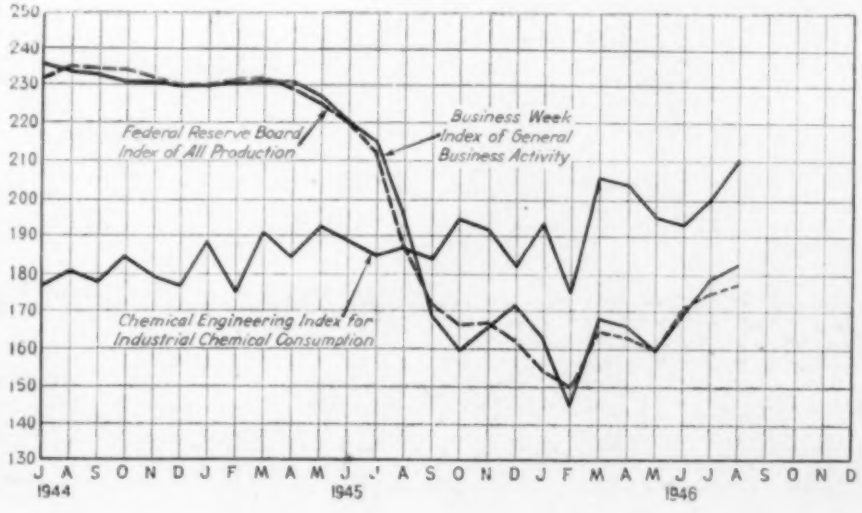
While labor troubles still continue to exert a retarding influence on industry, the most serious problem over the remainder of the year so far as chemicals are concerned seems to center in the possibility that deliveries of raw materials and finished products may be affected by a shortage of boxcars. The situation has been improved by overhauling old cars and by speeding up production of new cars as well as the more prompt return of empties. However, the prospective larger tonnage to be moved from now on gives rise to the fear that scarcity of transportation equipment may be felt to a point beyond anything yet experienced.

The unfavorable position of soda ash is giving some concern. In the first place, demand has been running ahead of supply with the deficit for the year estimated at 500,000 tons and the output of some chemicals which use ash as a raw material, has been held in check. The recent decision which grants allocations of ash for production of alumina can be carried out only by reducing shipments to regular consumers by an equal amount. Producers of ash have been doing all they can to hold their outputs at the highest possible level and no relief from increased production can be looked for in the near future. Hence it is almost certain that some lines of chemical manufacture will be curtailed until such time as ash is in more liberal supply. Interruption of production of ash in Canada has cut supplies so drastically that some consuming plants have been forced to close.

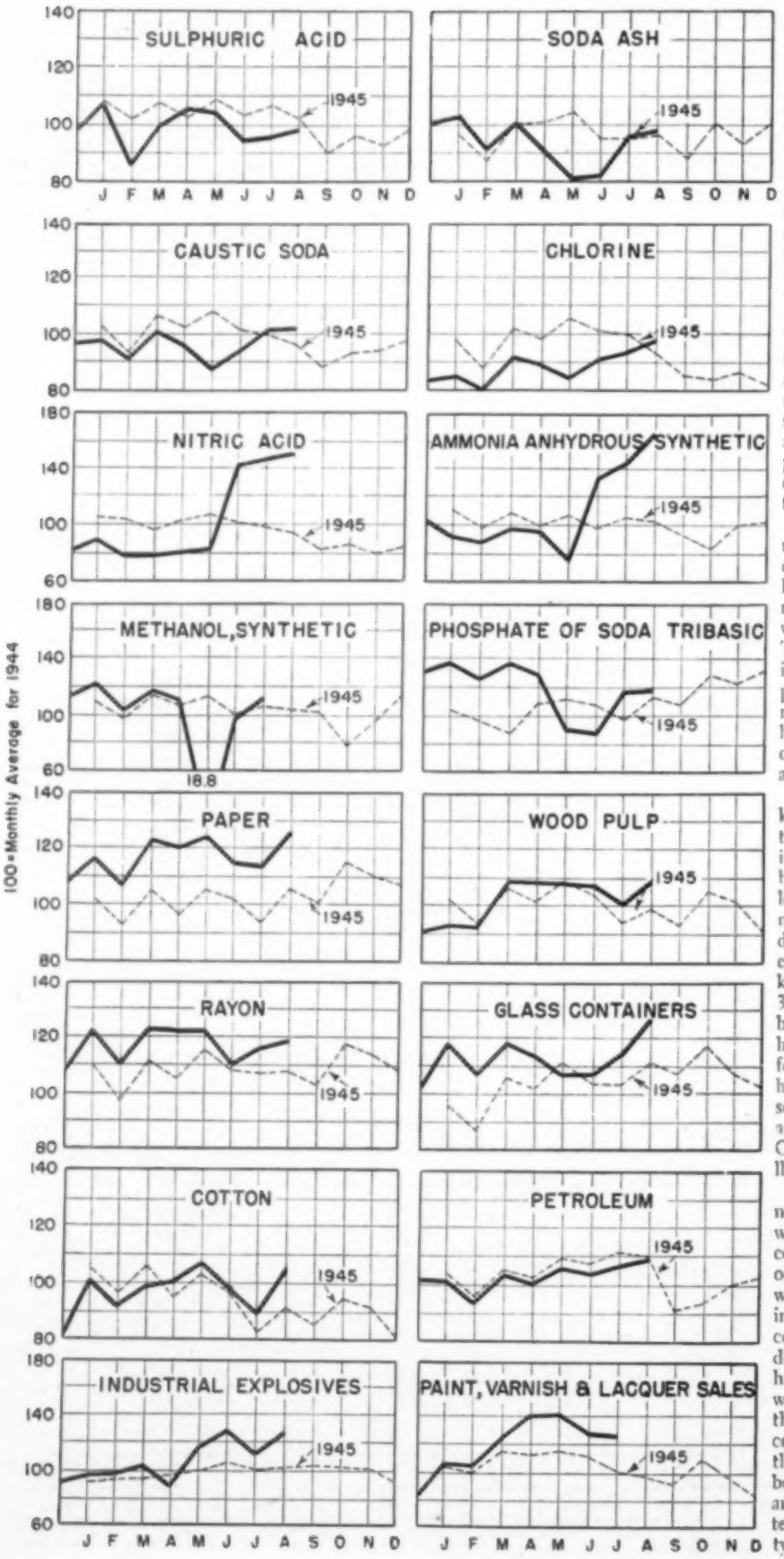
Inventory stocks continue to rise in value and probably to a lesser extent in volume but the pace slackened in August and in the case of chemicals, shortages are more common than surpluses. In addition to soda ash, there is a tight situation in the entire alkali branch of the industry. A further cut in lead allotments for the fourth quarter will further reduce the supply of lead pigments and there is not much hope for improvement in the position of most paint-making materials. Chemical companies were able to place sizable orders for silver in September and offerings of the metal have increased enough to cause a drop in sales prices. The shortage in silver nitrate which was acute a few months ago has now been overcome but production costs have risen appreciably.

***Chemical Engineering* Index**
Industrial Consumption of Chemicals
1935 = 100

	July Revised	Aug.
Fertilizers	42.40	44.94
Pulp and paper	19.98	22.30
Petroleum refining	19.60	19.71
Glass	22.08	23.95
Paint and varnish	21.16	21.50
Iron and steel	12.57	12.77
Rayon	19.76	20.10
Textiles	10.19	11.48
Coal products	9.67	9.80
Leather	4.60	4.10
Explosives	6.17	6.92
Rubber	6.60	6.90
Plastics	6.95	6.20
	201.43	210.67



PRODUCTION AND CONSUMPTION TRENDS



PRICE TRENDS for chemicals continue on a rising line with recent advances including a 5 percent increase for such basic materials as soda ash, caustic soda, and chlorine. These chemicals held an unchanged price course throughout the war years despite higher costs of production, which incidentally have gone still higher since the termination of the war. Consuming requirements have been running above current outputs and in the case of soda ash, priorities have been established over deliveries. It has been estimated that ash production this year will fall short by 500,000 tons of filling all demands. Plants have been worked steadily for the last six years with no respite for overhauling and replacements and as a result the equipment is in poor shape but, where possible, still is pushed to capacity in order to avoid a much more acute supply position. Apparently there will be little change in conditions until new plants will be ready to operate probably late in 1947.

Prices for vegetable oils also have been moving upwards with stocks of fats and oils reported to be the lowest in 20 years. Prices for all oil-bearing materials have risen and in addition there has been a vast preponderance of demand over supply. The supply picture for nearby months is improved by the probability of larger imports of copra and by the movement to market of domestic crops of linseed, soybeans, and peanuts but indicated supplies of domestic raw materials for a year ahead are less favorable.

Recent developments in the rubber market may be important as an indication that the natural product will be available in large volume in a shorter time than had been anticipated with a consequent lowering in the amount of synthetic rubber needed to round out requirements. Production of crude rubber in Malaya has exceeded expectations with current marketings reported to be considerably above 30,000 tons a month and, as stocks have been accumulating for some time, there has been strong agitation for offering it for sale in an unrestricted market. Prices have weakened under the pressure of unsold stocks and a short time ago it was announced that the Rubber Development Corp. would buy 10,000 tons at 20.25c. a lb. for early shipment to this country.

Early this month it was further announced that an additional 200,000 tons would be purchased for shipment to this country before December 31. Offerings of this magnitude if they are to continue will go far toward placing crude rubber in a position where next year it may compete for a high percentage of total domestic consumption. On the other hand, authorities in the industry say that whether or not crude rubber is available, the use of synthetic in rubber goods will continue to increase. It also is pointed out that synthetic can be sold considerably below the present asking prices for crude and possibly price considerations may determine the relative proportions of the types actually consumed.

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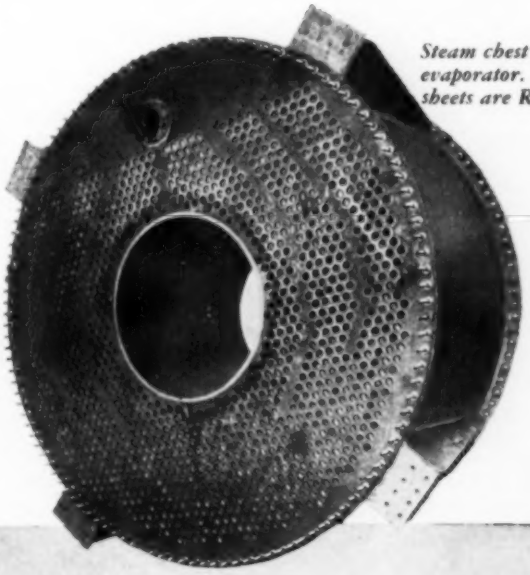
There are many different Revere Metals, because no one metal can possibly serve all purposes. The important thing is to select among these metals those most suitable for each given set of conditions. Sometimes this is not easy, requiring a skilful balancing of such factors as corrosion resistance, strength, weight, cost per pound, cost per cubic foot, cost of fabrication, time consumed in fabrication, service expectancy, and even appearance. We will gladly discuss with you the many, varied, and sometimes contrasted virtues of Revere Metals, either in general terms, or in relation to a specific product or piece of equipment.

Revere Mill Products include—*Copper and Copper Alloys:* Sheet and Plate, Roll and Strip, Rod and Bar, Tube and Pipe, Extruded Shapes, Forgings; *Aluminum Alloys:* Tube, Extruded Shapes, Forgings; *Magnesium Alloys:* Sheet and Plate, Rod and Bar, Tube, Extruded Shapes, Forgings; *Steel:* Electric Welded Steel Tube.

Catchall, 90" x 5' 5" face to face, made of Herculoy.



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United States Production of Certain Chemicals

July 1946, July 1945 and Seven-Month Totals for 1946 and 1945

Chemical and Basis	Unit	July 1946	July 1945	Total, 7 Months 1946	Total, 7 Months 1945
Ammonia, synthetic, anhydrous[1]	Tons	65,048	47,431	328,910	330,136
Ammonium nitrate (100% NH_4NO_3)	Tons	62,658	.....	322,478	.....
Ammonium sulphate, synthetic, tech	M lb.	16,658	.....	119,266	.....
Calcium arsenate (100% $Ca_3(AsO_4)_2$)	M lb.	6,438	4,582	20,508	19,804
Calcium carbide, commercial	Tons	48,716	62,480	298,583	436,270
Calcium phosphate:					
Monobasic (100% $CaH_4(PO_4)_2$)	M lb.	6,485	4,693	40,254	35,491
Dibasic (100% $CaHPO_4$)	M lb.	5,829	3,589	45,671	24,500
Carbon dioxide:					
Liquid and gas	M lb.	20,741	18,754	122,663	125,201
Solid (dry ice)	M lb.	67,396	70,004	370,113	399,556
Chlorine	Tons	98,314	105,189	650,633	729,183
Chrome green (C.P.)	M lb.	1,416	411	11,511	3,305
Chrome yellow and orange (C.P.)	M lb.	3,471	3,954	27,400	23,048
Hydrochloric acid (100% HCl)	Tons	27,960	35,891	189,060	254,453
Hydrogen	M. cu. ft.	1,474,000	.....	9,742,000	.....
Lead arsenate (acid and basic)	M lb.	1,848	3,802	45,940	51,320
Molybdate chrome orange (C.P.)	M lb.	430	59	2,996	841
Nitric acid (100% HNO_3)	Tons	57,056	38,944	273,114	279,322
Oxygen	M cu. ft.	904,083	1,180,602	13,866,954	9,363,610
Phosphoric acid (50% H_3PO_4)	Tons	61,770	59,957	476,552	395,826
Soda ash (commercial sodium carbonate):					
Ammonia soda process (98–100% Na_2CO_3):					
Total wet and dry[2]	Tons	361,056	358,217	2,425,728	2,561,469
Finished light[2]	Tons	172,259	192,842	1,292,462	1,374,420
Finished dense	Tons	131,776	121,122	856,675	813,119
Natural[3]	Tons	19,915	15,540	120,089	107,017
Sodium bicarbonate, refined	Tons	15,013	11,332	117,512	96,822
Sodium bichromate and chromate	Tons	6,864	6,244	50,728	46,459
Sodium hydroxide (100% NaOH):					
Electrolytic process:					
Liquid[4]	Tons	95,638	100,920	629,803	691,672
Solid	Tons	15,994	19,302	109,762	132,191
Lime soda process:					
Liquid[4]	Tons	64,709	56,724	427,489	432,383
Solid	Tons	19,495	19,455	134,935	141,865
Sodium Phosphate:					
Monobasic (100% NaH_2PO_4)	Tons	952	1,225	6,522	8,621
Dibasic (100% Na_2HPO_4)	Tons	4,180	5,413	33,059	34,203
Tribasic (100% Na_3PO_4)	Tons	7,913	6,632	56,308	48,111
Meta (100% $NaPO_3$)	Tons	2,284	2,633	15,960	15,464
Tetra (100% $Na_4P_2O_7$)	Tons	3,802	3,673	44,265	22,496
Sodium silicate (anhydrous)	Tons	39,152	32,960	32,386	265,621
Sodium sulphate:					
Anhydrous (refined) (100% Na_2SO_4)	Tons	10,675	5,024	125,163	46,177
Glaubers salt	Tons	12,724	16,308	105,036	126,574
Salt cake, crude, commercial	Tons	42,945	46,011	252,086	316,544
Sulphuric acid (100% H_2SO_4):[5]					
Chamber process	Tons	228,824	248,472	1,745,573	1,884,939
Net, contact process[6]	Tons	450,143	514,224	3,123,300	3,401,466
Zinc yellow	Tons	247	1,309	.....	11,109

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census and WPB Chemicals Bureau. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given, data are either confidential or not yet available. [1] Includes a small amount of aqua ammonia. [2] Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3] Not including quantities converted to finished dense. [4] Data collected in cooperation with the Bureau of Mines. [5] Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6] Includes oleum grades, excludes spent acid. [7] Data for sulphuric acid manufactured as a byproduct of smelting operations are included.

United States Production of Certain Synthetic Organic Chemicals

June 1946, June 1945 and Six-Month Totals for 1946 and 1945

Chemical	June 1946	June 1945	Total, 6 Months 1946	Total, 6 Months 1945
Acetanilid, technical and U.S.P.	624,448	.....	3,515,476	.....
Acetic acid:				
Synthetic[1]	23,527,441	23,358,276	133,336,206	141,886,923
Recovered[1,2]	93,380,010	.....	571,909,262	.....
Natural	2,475,544	2,991,009	12,803,130	17,928,801
Acetic anhydride[3]	42,545,646	46,413,796	256,183,185	272,800,318
Acetone	27,756,869	.....	160,781,715	.....

(*Continued on page 324*)

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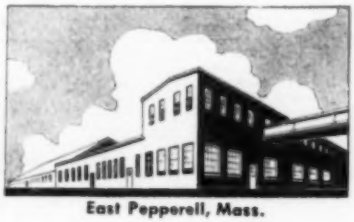
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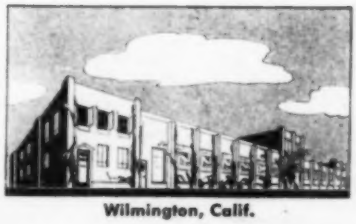
Mobile, Ala.

San Francisco, Calif.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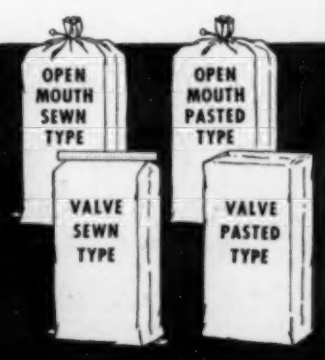

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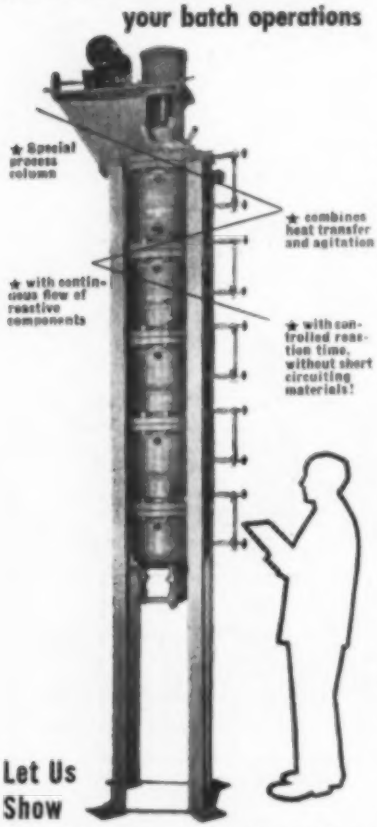
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U. S. Production of Synthetic Organic Chemicals (Cont. from page 322)

Chemical	June 1946	June 1945	Total, 6 Months 1946	Total, 6 Months 1945
Aniline	6,988,687	.....	41,417,529	.....
Acetylsalicylic acid	676,315	882,853	5,561,643	5,383,625
Barbituric acid derivatives:[2]				
5-Ethyl-5 Phenylbarbituric acid and salts (Phenobarbital)	29,115	21,199	195,384	145,585
Benzene:				
Motor grade:				
Tar distillers[4]	707,589	.....	5,375,805	.....
Coke-oven operators[5]	2,527,819	.....	13,780,655	.....
All other grades:				
Tar distillers[4]	2,064,339	.....	12,104,405	.....
Coke-oven operators[5]	8,269,294	.....	43,439,290	.....
Butyl alcohol, primary, normal	7,340,500	.....	49,018,393	.....
Carbon bisulphide	26,032,302	.....	146,601,337	.....
Carbon tetrachloride	11,231,323	.....	68,510,286	.....
Chlorobenzene, mono	22,497,058	.....	133,898,855	.....
Creosote oil:				
Tar distillers	8,178,030	10,743,983	54,786,222	67,356,007
Coke-oven operators	1,923,136	2,871,196	10,713,839	18,716,915
Cresols:[7]				
Meta-para	134,701	362,179	2,066,561	3,961,858
Ortho-meta-para	587,298	1,466,427	.....	4,689,031
Cresylic acid, refined[7]	1,902,690	2,076,816	10,289,912	15,044,725
Dibutyl phthalate	888,470	.....	.....	.....
Dichloro-diphenyl-trichloroethane (DDT)	3,542,015	.....	21,853,298	.....
Ethyl acetate (85 percent)	6,542,137	7,902,427	41,915,175	55,041,790
Ethyl ether, technical and U.S.P.	3,236,276	7,460,412	17,256,387	47,769,273
Formaldehyde (37 percent by wt.)	30,602,848	.....	124,309,227	.....
Methanol:				
Natural	1,315,384	1,660,000	[9] 7,867,543	[9] 9,809,696
Synthetic	39,030,932	39,919,000	226,426,637	253,501,920
Naphthalene:				
Tar distillers (Less than 79° C.)[4]	11,004,356	16,276,648	85,203,437	100,588,838
Tar distillers (79° C. and over)[4]	6,999,214	5,980,097	48,353,824	34,832,202
Coke-oven operators (Less than 79° C.)[5]	5,156,055	7,559,767	26,201,938	45,319,288
Penicillin[8]	2,170,748	.....	12,491,468	.....
Phenol (synthetic and natural)	18,322,061	.....	100,824,562	.....
Phthalic anhydride	7,739,056	11,802,442	51,116,013	67,015,450
Styrene (government owned plants only)	34,833,300	.....	183,967,934	.....
Toluene:				
Coke-oven operators[5]	1,113,202	.....	7,851,849	.....
All other[5] [10]	1,426,686	.....	6,574,824	.....

All data in pounds except benzene (gal.), creosote oil (gal.), toluene (gal), and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1] Excludes the statistics on recovered acid. [2] Acid produced by direct process from wood and from calcium acetate. [3] All acetic anhydride including that from acetic acid by vapor-phase process. [4] Product of distillers who use purchased coal tar only. [5] Statistics are given in terms of bulk medicinals only. [6] Statistics collected by Bureau of Mines. [7] Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8] Reported to U. S. Bureau of the Census. [9] Reported in gal. by Bureau of the Census but converted to lb. for comparison with the production of synthetic methanol. [10] Includes toluene produced from petroleum by any process.

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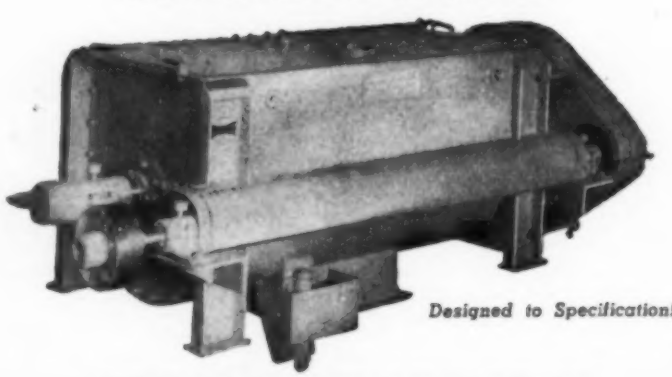

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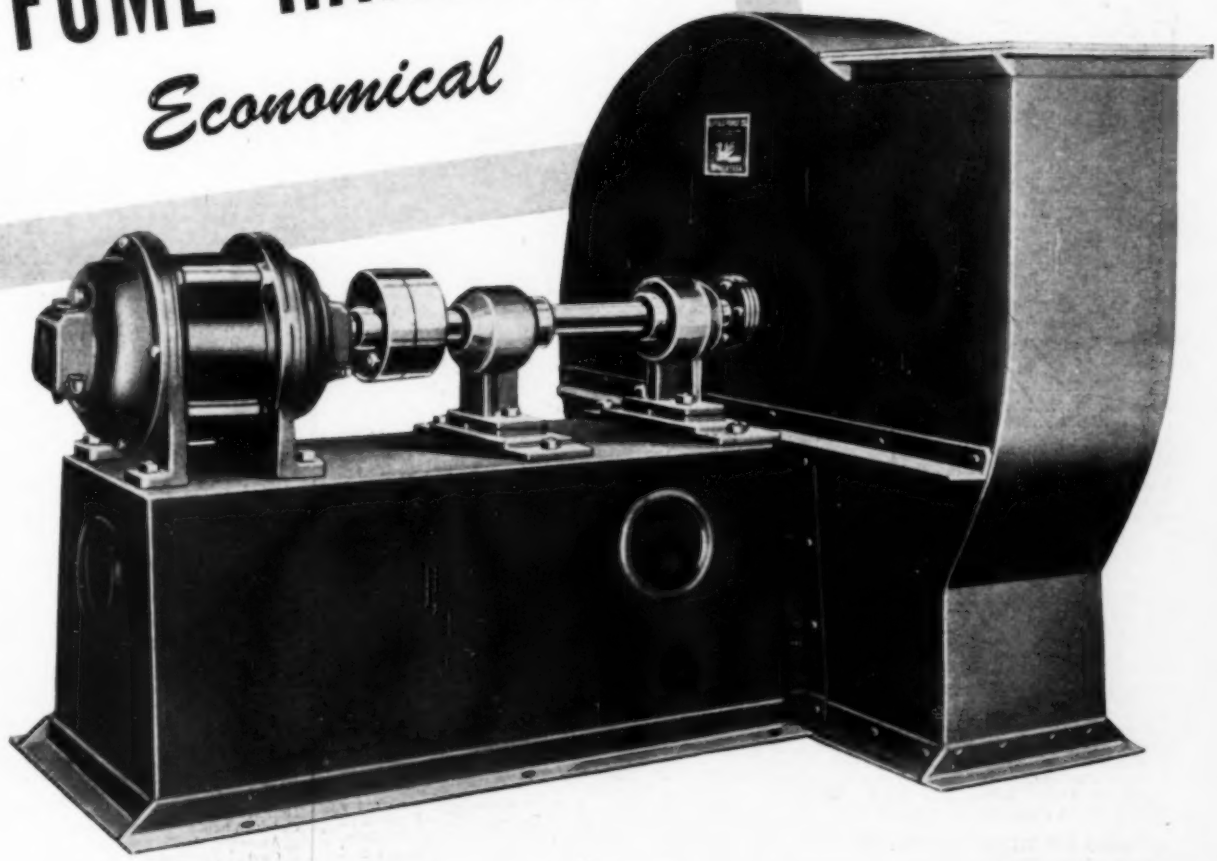

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CHEMISTRY OF THE SILICONES

By EUGENE G. ROCHOW, *Research Chemist, General Electric Company*

1946 **137 Pages** **$2.75**

This important new book offers the chemist, engineer and industrial designer a comprehensive survey of our present knowledge in the field. It presents the information necessary to understand the behavior of organosilicon materials and to use them intelligently. The silanes and their derivatives are reviewed in detail. Those silicon polymers which have achieved commercial importance are discussed, as are the methods for their preparation, chemical and physical properties, and possible uses. A review of methods of analysis is included and the processes available for large-scale production are discussed separately. The book includes many references to the literature, tables of most of the known compounds and their properties, and an extensive glossary of terms.

EXPERIMENTAL PLASTICS AND SYNTHETIC RESINS

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Edited by ROGER ADAMS and a Staff of 13 Editors

1946 **460 Pages** **$5.00**

A discussion of nine widely used reactions from the preparative point of view. Includes scope and limitations, experimental directions, side reactions, tabulation of results. An extensive bibliography follows each chapter, as well as tables listing compounds prepared by or subjected to the reaction under discussion.

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CHEMICAL ENGINEERING
Weighed Index of Prices for CHEMICALS

Base = 100 for 1937

This month	**111.82**
Last month	111.36
October, 1945	108.72
October, 1944	109.40

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to October 10.

INDUSTRIAL CHEMICALS

Acetone, tanks, lb	$0.07 –
Acid, acetic, 29% bbl., 100 lb	3.38 – $3.63
Boric, bbl., ton	109.00 – 113.00
Citric, drums, lb	.22½ – .23
Formic, cbys, lb	.10½ – .11
Hydrofluoric, 30%, drums, lb	.08 – .085
Lactic, 44% tech., light, bbl., lb	.073 – .075
Muriatic, 18°, tanks, 100 lb	1.05 –
Nitric, 36°, carboys, lb	.05 – .02½
Oleum, tanks, wks, ton	18.50 – 20.00
Oxalic, crystals, bbl., lb	.11½ – .12½
Phosphoric tech., tanks, lb	.04 –
Sulphuric, 60°, tanks, ton	13.00 –
Tartaric, powd., bbl., lb	.54½ – .56
Alcohol, amyl from pentane, tanks, lb	.131 –
Alcohol, butyl, tanks, lb	.10½ – .216
Alcohol ethyl, denatured, No. 1 special, tanks, gal	.542 –
Alum, ammonia, lump, lb	.04½ –
Aluminum sulphate, com. bags, 100 lb	1.15 – 1.45
Ammonia, anhydrous, cyl., lb	.14½ –
tanks, ton	59.00 – 61.50
Ammonium carbonate, powd., casks, lb	.09½ – .10
Sulphate, wks., ton	30.00 –
Amyl acetate, tech. from pentane, tanks, lb	.15½ –
Aqua ammonia, 26°, drums, lb	.02½ – .03
tanks, ton	65.00 –
Arsenic, white, powd., bbl., lb	.05 – .05½
Barium carbonate, bbl., ton	65.00 – 75.00
Chloride, bbl., ton	75.00 – 78.00
Nitrate, casks, lb	.09½ – .11
Blanc fixe, dry, bags, ton	60.00 – 70.00
Bleaching powder, f.o.b., wks., drums, 100 lb	2.50 – 3.00
Borax, gran., bags, 100 lb	45.00 –
Calcium acetate, bags, 100 lb	3.00 –
Arsenate, dr., lb	.07½ – .08
Carbide, drums, ton	50.00 –
Chloride, flake, bags, del., ton	18.50 – 25.00
Carbon bisulphide, drums, lb	.05 – .05
Tetrachloride, drums, gal	.73 – .80
Chlorine, liquid, tanks, wks., 100 lb	1.75 – 2.00
Copperas, bgs., f.o.b., wks., ton	17.00 – 18.00
Copper carbonate, bbl., lb	.19½ – .20
Sulphate, bbl., 100 lb	5.65 – 6.15
Cream of tartar, bbl., lb	.45 – .50
Diethylene glycol, dr. lb	.14½ – .15½
Epsom salt, dom., tech., bbl., 100 lb	1.80 – 2.00
Ethyl acetate, tanks, lb	.08½ – .11½
Formaldehyde, 30%, tanks, lb. wks.	.032 –
Furfural, tanks, lb	.09½ –
Glaubers salt, bags, 100 lb	1.05 – 1.10
Glycerine c.p. drums, extra, lb	.18½ – .19
Lead: White, basic carbonate, dry, casks, lb	.10 –
Red, dry, sck., lb	.10½ –
Lead acetate, white crys., bbl., lb	.12½ – .13
Arsenate, powd., bags, lb	.13½ – .14½
Lithopone, bags, lb	.044 – .049
Magnesium carb., tech., bags, lb	.07½ – .08
Methanol, 95%, tanks, gal	.60 –
Synthetic, tanks, gal	.24 –
Phosphorus, yellow, cases, lb	.23 – .25
Potassium bichromate, bags, lb	.10 – .10½
Chlorate, powd., lb	.09½ – .12
Hydroxide (c'stic potash) dr., lb.	.07 – .07½
Muriate, 60%, bags, unit	.53½ –
Nitrate, ref., bbl., lb	.08 – .09
Permanganate, drums, lb	.19½ – .20
Prussiate, yellow, casks, lb	.16 – .17
Sal ammoniac, white, casks, 100 lb.	4.50 – 5.00
Salsoda, bbl., 100 lb	1.00 – 1.05
Salt cake, bulk, ton	15.00 –
Soda ash, light, 58%, bags, contract, 100 lb	1.05 –
Dense, bags, 100 lb	1.15 –
Soda, caustic, 76% solid, drums, 100 lb	2.30 – 3.00
Acetate, del., bbl., lb	.05½ – .06
Bicarbonate, bbl., 100 lb	1.70 – 2.00
Bichromate, bags, lb	.07½ – .08
Bisulphate, bulk, ton	16.00 – 17.00
Bisulphite, bbl., lb	.03 – .04

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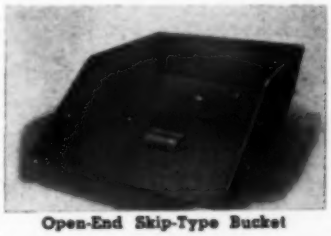

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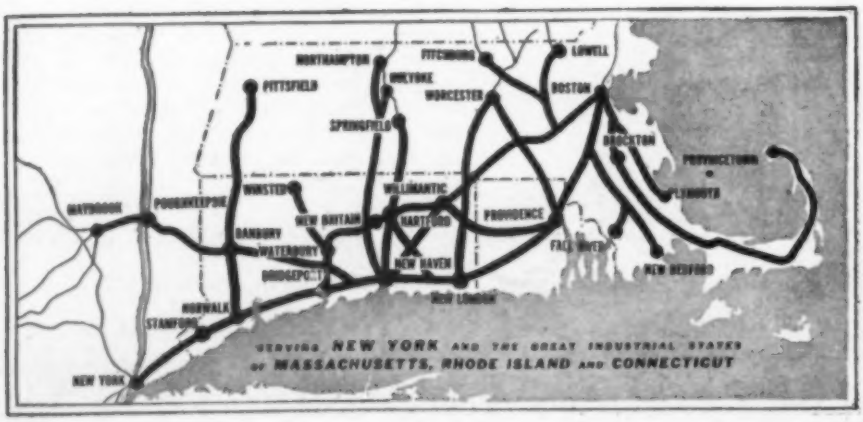


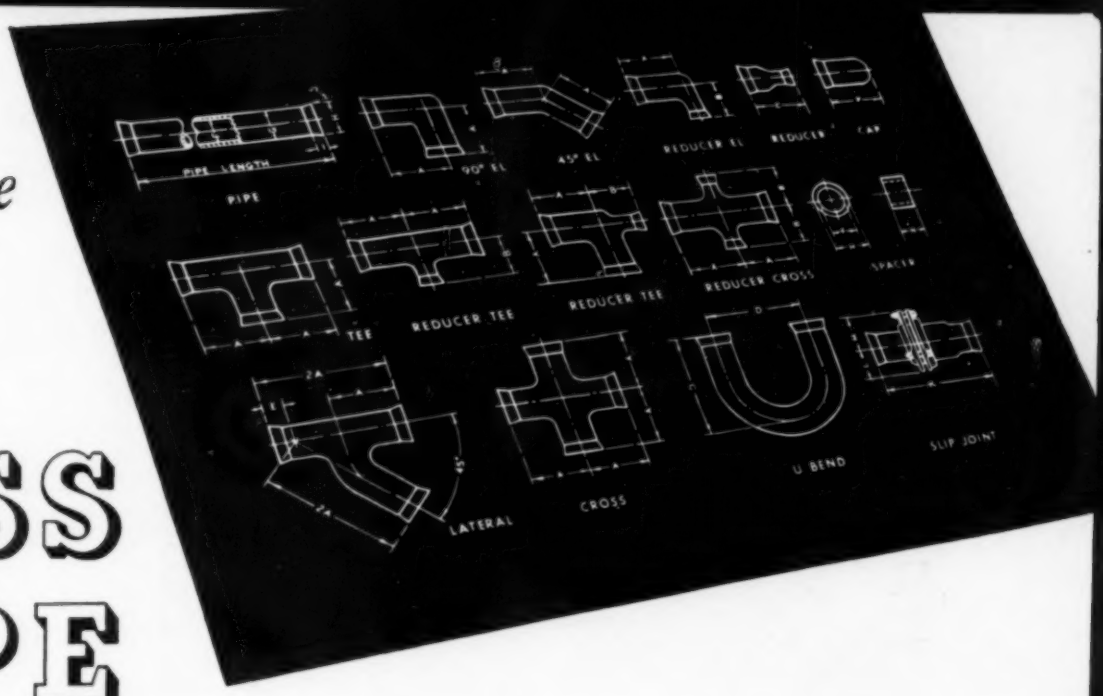
CHEMICAL ENGINEERING
Weighed Index of Prices for OILS & FATS

BASE = 100 for 1937

This month	**161.52**
Last month	152.23
October, 1945	145.63
October, 1944	154.04

Chlorate, kegs, lb	$0.06½ –	$0.06¾
Cyanide, cases, dom. lb	.14½ –	.15
Fluoride, bbl., lb	.07 –	.08
Hyposulphite, bags, 100 lb	2.25 –	2.50
Metasilicate, bbl., 100 lb	2.50 –	2.65
Nitrate, bulk, ton	27.00 –	
Nitrite, casks, lb	.06½ –	.07
Phosphate, tribasic bags, 100 lb	2.70 –	
Prussiate, yel., bags, lb	.10½ –	.11
Silicate, 40°, dr., wks., 100 lb	.80 –	.85
Sulphite, crys., bbl., lb	.02½ –	.02¾
Sulphur, crude at mine, long ton	16.00 –	
Dioxide, cyl., lb	.07 –	.08
Dioxide, tanks, lb	.04 –	
Tin crystals, bbl., lb	.39½ –	
Zinc chloride, grains, bbl., lb	.05½ –	.06
Oxide, lead free, bags, lb	.08½ –	
Oxide, 5% leaded, bags, lb	.08½ –	
Sulphate, bbl., cwt	3.85 –	4.00
OILS AND FATS		
Castor oil, No. 3 bbl., lb	$0.20 –	$0.21
Chinawood, oil, tanks, lb	.39 –	
Coconut oil, ceylon, N. Y., lb	.0885–	
Corn oil crude, tanks (f.o.b. mill), lb.	.12½ –	
Cottonseed oil crude (f.o.b. mill), tanks, lb	.14½ –	.15½
Linseed oil raw, car lots, dr., lb	.188–	
Palm, casks, lb	.0865–	
Peanut oil, crude, tanks (mill), lb	.14½–	
Rapeseed oil, refined, bbl., lb	nom.	
Soybean, tanks, lb	.13½–	
Menhaden, light, pressd. dr., lb	.13 –	
Crude, tanks (f.o.b. factory), lb	.089–	
Grease, yellow, loose, lb	.08½–	
Oleo stearine, lb	.09½–	
Oleo oil, No. 1, lb	.13 –	
Red oil, distilled, bbl., lb	.13½–	
Tallow extra, loose, lb	.08½–	
COAL-TAR PRODUCTS		
Alpha-naphthol, crude, bbl., lb	$0.52 –	$0.55
Alpha-naphthylamine, bbl., lb	.32 –	.34
Aniline oil, drums, lb	.11½–	.13½
Aniline salts, bbl., lb	.22 –	.24
Benzaldehyde, tech., dr., lb	.45 –	.50
Benzidine base, bbl., lb	.70 –	.75
Benzoic acid, USP, kegs, lb	.54 –	.56
Benzol, 90%, tanks, works, gal	.15 –	
Benzyl chloride, tech., dr., lb	.22 –	.24
Beta-naphthol, tech., drums, lb	.21 –	.22
Cresol, USP, dr., lb	.11½–	
Cresylic acid, dr., wks., gal	.81 –	.83
Diphenyl, bbl., lb	.15 –	
Diethylaniline, dr., lb	.40 –	.45
Dinitrotoluol, bbl., lb	.18 –	.19
Dinitrophenyl, bbl., lb	.22 –	.23
Dip oil, 15%, dr., gal	.23 –	.25
Diphenylamine, dr., f.o.b. wks., lb	.25 –	
H acid, bbl., lb	.45 –	.50
Hydroquinone, bbl., lb	.90 –	
Naphthalene, flakes, bbl., lb	.09½–	.10
Nitrobenzene, dr., lb	.08 –	.09
Para-cresol, bbl., lb	.41 –	
Para-nitroaniline, bbl., lb	.42 –	.43
Phenol, USP, drums, lb	.10 –	.11
Picric acid, bbl., lb	.35 –	.40
Pyridine, dr., gal	1.55 –	1.60
Resorcinol, tech., kegs, lb	.65 –	.70
Salicylic acid, tech., bbl., lb	.26 –	.33
Solvent naphtha, w.w., ranks, gal	.26 –	
Toluidin, bbl., lb	.96 –	
Toluol, drums, works, gal	.27 –	
Xylol, com., tanks, gal	.32 –	
MISCELLANEOUS		
Casein, tech., bbl., lb	$0.33 –	$0.35
Dry colors:		
Carbon gas, black (wks.), lb	.0365–	.097
Prussian blue, bbl., lb	.36 –	.37
Ultramarine blue, bbl., lb	.11 –	.38
Chrome, green, bbl., lb	.24 –	.33
Carmine, red, tins, lb	5.50 –	6.00
Para toner, lb	.75 –	.80
Vermilion, English, bbl., lb	2.50 –	2.60
Chrome yellow, C.P., bbl., lb	.17 –	.18
Gum copal, Congo, bags, lb	.09 –	.55
Manila, bags, lb	.09 –	.15
Damar, Batavia, cases, lb	.10 –	.22
Kauri, cases, lb	.18 –	.60
Magnesite, cale., ton	64.00 –	
Pumice stone, lump, bbl., lb	.05 –	.07
Rosin, H., 100 lb	8.67 –	
Shellac, orange, fine, bags, lb	.70 –	
Bleached, bonedry, bags, lb	.69 –	
T. N. bags, lb	.71 –	
Turpentine, gal	1.16 –	

A Complete Line of Standard Fittings for GLASS PIPE



re is a complete line of Pyrex brand Glass Pipe Fittings eet the requirements of any installation. These Stan- fittings are available in 1″, 1½″, 2″, 3″ and 4″. Special gs can be made to order.

nsequently it is easy to install this practical, eco- ical pipe. Once installed you will cash in on its unique bination of qualities.

s resistance to thermal shock permits cleaning by flushing with steam or hot water immediately followed with cold rinse water. Its chemical stability, visibility and purity maintenance contribute to its long, trouble-free service. Its transparency enables you to visually inspect every inch of the pipe and its contents.

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TAINING PRODUCT PURITY. PYREX Pipe is resistant to all acids t H.F.) and moderate alkalis. There is no heavy metal pick-up or of metallic contamination. PYREX Pipe lines assure the ultimate aining product purity.

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AND FITTINGS. PYREX Glass Pipe is now available in 1″, 1½″, and 4″. A complete line of standard PYREX fittings includes ells, turn bends, laterals and reducers. Special fittings can be readily to your specifications.

Standard fittings and adaptor connections are available to connect PYREX Pipe to your present equipment.

LOW COST. The initial cost of PYREX Pipe (accessories included) is about the same or less than the cost of full weight copper or brass piping in comparable sizes, and is considerably less than the cost of most other corrosion resistant alloys. Whether you figure costs of new equipment in terms of initial outlay or in terms of over-all costs—spread over the length of service it will give you—PYREX Pipe is your best bet.

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NEW CONSTRUCTION

PROPOSED WORK

Calif., Alameda—Kieckhefer Container Co., 2 Pine St., San Francisco, plans to construct a fibreboard products factory. Estimated cost $600,000.

Calif., Mountain View—Stauffer Chemical Co., 636 California St., San Francisco, plans to construct a 1 story research laboratory here. Estimated cost $100,000.

Conn., Norwalk—Charles of the Ritz, Norwalk, is having plans prepared by Fletcher-Thompson, Inc., 211 State St., Bridgeport, for a cosmetics factory. Estimated cost $450,000.

Del., Wilmington—E. I. du Pont de Nemours & Co., Inc., du Pont Bldg., is having plans prepared by Voorhees, Walker, Foley & Smith, Archts., 101 Park Ave., New York, N. Y., and F. A. Godley, 247 Park Ave., New York, N. Y., Assoc. Archt., for expanding its experimental station. Estimated cost $17,000,000.

Ga., Macon—Welding Supplies, Inc., c/o C. W. Farmer, Pres., plans to construct an oxygen and acetylene gases manufacturing factory. Estimated cost $100,000.

Ill., Joliet—Blockson Chemical Co., Joliet, is having plans prepared by Dubin & Dubin, 127 North Dearborn St., Chicago, for a 2 and 3 story chemical laboratory and administration building. Estimated cost $200,000.

Mont., Anaconda—Anaconda Copper Mining Co. plans to construct a phosphoric acid plant. Estimated cost $1,068,958.

Mont., Billings—Carter Oil Co., Billings, plans to construct a refinery. Estimated cost $8,000,000.

O., Toledo—Libbey Glass Div., Owens-Illinois Glass Co., Ash St., plans to alter and construct additions to its factory and warehouse here. Estimated cost $893,000.

Ore., Portland—Fibreboard Products Co., Russ Bldg., San Francisco, Calif., plans to construct a 200x650 ft. carton factory. Leland S. Rosener & Co., Sansome St., San Francisco, Cons. Eng. Estimated cost $1,000,000.

Tex., Texas City—Monsanto Chemical Co., Texas City, plans to construct new plant unit for the manufacture of Styrene plastic; also convert and improve existing plant. Estimated cost $750,000 and $500,000 respectively.

Utah, Devils Slide—Ideal Cement Co., C. Boettcher, Pres., Denver National Bank Bldg., Denver, Colo., plans to construct a cement manufacturing plant. Estimated cost $2,500,000.

CONTRACTS AWARDED

Ark., El Dorado—Lion Oil Co., El Dorado, will construct three 45-day ammonia-oxidation units for production of nitric acid. Work will be done by owner. Estimated cost $750,000.

Calif., Richmond—Standard Oil Co. of California, 225 Bush St., San Francisco, has awarded the contract for a 1 and 2 story laboratory and office building to Swinerton & Walberg Co., 225 Bush St. Estimated cost $55,000.

	Current Projects		Cumulative 1944	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$450,000	$1,060,000	$1,165,000	$7,204,000
Middle Atlantic	17,000,000	1,830,000	26,096,000	33,216,000
South	100,000	20,200,000	61,042,000	92,940,000
Middle West	1,093,000	35,000,000	15,639,000	74,015,000
West of Mississippi	10,319,000	13,100,000	99,455,000	98,293,000
Far West	4,200,000	4,061,000	12,055,000	30,321,000
Canada	.....	.....	405,000	.....
Total	$33,162,000	$75,251,000	$215,857,000	$335,989,000

Calif., Whittier—Cherry River Paper Co., 205 North Glendale Ave., Glendale, has awarded the contract for a manufacturing plant to Waale Camplan Co. & Smith, Inc., 1670 Beverly Blvd., Los Angeles. Estimated cost $250,000.

Ill., Chicago—Velsicol Corp., 120 East Pearson St., has awarded the contract for the construction of a 3 story, 86x194 ft. factory and laboratory to C. Rasmussen Corp., 1448 West Adams St. Estimated cost $500,000.

Mass., Watertown—Hood Rubber Co., 98 Nichols St., will construct a 1 story, 90x100 ft. addition to its plant. Work will be done by owner. Estimated cost $60,000.

Mich., Wyandotte—Wyandotte Chemical Co., Biddle Ave., has awarded the contract for 11 buildings for chemical plant expansion to Cunningham Rudy Co., 3087 West Grand Blvd., Detroit. Estimated cost $25,000,000.

N. H., Tilton—Johns-Manville Corp., 22 East 40th St., New York, N. Y., plans to construct a 1 and 2 story manufacturing plant and auxiliary buildings here. Work will be done by separate contract under supervision of H. A. Kuljian & Co., Eng., 1518 Walnut St., Philadelphia, Pa. Estimated cost $1,000,000.

N. J., Trenton—Bayer Co., 175 Varick St., New York, N. Y., has awarded the contract for the design and construction of an acid recovery plant to The Austin Co., 19 Rector St., New York, N. Y. Estimated cost $115,000.

N. Y., North Tonawanda—Durez Plastics & Chemicals, North Tonawanda, has awarded the contract for a 1 story, 160x200 ft. finished products warehouse to Siegfried Construction Co., Inc., 6 North Pearl St., Buffalo, N. Y. Estimated cost $400,000.

O., Toledo—Grasselli Chemical Div. of E. I. du Pont de Nemours & Co., Du Pont Bldg., Wilmington, Del., has awarded the contract for a 1 story, 34x134 ft. plant at Stickney Ave. and Matzinger Rd., to Graver Tank & Mfg. Co., Inc., 242 Madison Ave., New York, N. Y. Estimated cost $1,500,000.

O., Toledo—Standard Oil Co., 526 High St., Cleveland, has awarded the contract for design and construction of lubricating oil plant and refinery at Cedar Point, Otter Creek and Bay Shore Rds., East Toledo, to Lummus Co., 420 Lexington Ave., New York, N. Y. Estimated cost $8,000,000.

Pa., Linfield—Publicker Industrial Alcohol Co., 1429 Walnut St., Philadelphia, has awarded the contract for a 3 story, 200x200 ft. warehouse, Project D, to McCloskey & Co., 1620 W. Thompson St., Philadelphia. Estimated cost $250,000.

Pa., Philadelphia—Jaegle Paint & Varnish Co., 1607 South 20th St., has awarded the contract for alterations and additions to its factory to John P. Hallahan Co., 2015 Sanson St., Philadelphia. Estimated cost $55,000.

Pa., Phoenixville—Diamond Glass Co., Royersford, has awarded the contract for a manufacturing plant here to W. W. Lindsay, 4 South 15th St., Philadelphia. Estimated cost $750,000.

Pa., Royersford—Diamond Glass Co., Royersford, has awarded the contract for an addition to its plant here to W. W. Lindsay, 4 South 15th St., Philadelphia. Estimated cost $260,000.

Tenn., Chattanooga—E. I. du Pont de Nemours & Co., Inc., du Pont Bldg., Wilmington, Del., will construct a nylon yarn plant here with its own forces. Estimated cost $20,000,000.

Tenn., Memphis—U. S. Rubber Co., 713 Linden St., has awarded the contract for a 1 story, 150x300 ft. warehouse to Seth E. Giem, 166 Monroe Ave. Estimated cost $200,000.

Tex., Baytown—Humble Oil & Refining Co., Baytown, has awarded the contract for a solvent dewaxing plant to E. B. Badger & Sons Co., 75 Pitts St., Boston, Mass. Estimated cost $2,000,000.

Tex., Dallas—Eastman Kodak Co., 1504 Young St., will construct a color processing plant here. Work will be done by force account and subcontracts. Estimated cost $200,000.

Tex., Port Arthur—Gulf Oil Corp., Port Arthur, has awarded the contract for the construction of a polymerization unit and two desulphurization units to The Lummus Co., M. Esperson Bldg., Houston to cost $450,000 and $700,000 respectively; distillate or oil distillery plant to have a capacity of 8,000 bbl. crude oil daily and one to have a capacity of 12,000 bbl. daily, to E. B. Badger & Son, 75 Pitts St., Boston, Mass., to cost $2,000,000 and $3,000,000 respectively.

Tex., Texas City—Carbon & Carbide Chemical Corp., 30 East 42nd St., New York, N. Y., has awarded the contract for the design and construction of compressor building, equipment building, gas separation plant control building, pump house and electric control buildings to Ford, Bacon & Davis, c/o H. M. Hays, Texas City. Estimated cost $4,000,000.

Wash., Camas—Crown Zellerbach Corp., Public Service Bldg., Portland, Ore., has awarded the contract for additions to its pulp and paper plant to The Austin Co., 16112 Euclid Ave., Cleveland, O., at $3,756,088.